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WELSH PLANT BREEDING STATION

The Ryegrasses in British Agriculture: a Survey

By

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THE RYEGRASSES IN BRITISH AGRICULTURE: A SURVEY.

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PREFATORY NOTE

Delving into the literature of the past, into old books, manuscripts and documents, can be fascinating as well as instructive. Mr. Beddows, who is head of the Grass Breeding Department, has devoted much of his limited periods of leisure to a study of the history of the perennial and Italian ryegrasses. In these studies, which began many years ago, he has examined countless publications, miscellaneous papers and old documents in search of facts concerning the introduction and use of the grasses in British husbandry. In so doing he has made a valuable contribution to our knowledge of the history of these two important plant species. Although there still remain many gaps in our knowledge of these two species, such as their precise geographical origin and the time and manner of their introduction into the grassland husbandry of this country, this survey of the agricultural literature of the last three centuries has brought to light information of much interest and value, not only to the plant breeder and student of crop husbandry, but also to the farmer, seed merchant and herbage seeds grower.

Since little is known or recorded about the early improvers of perennial ryegrass, Pacey, Neil, Whitworth and others, it is hoped that readers in the areas where these pioneers lived may be stimulated by these researches to carry out local investigations.

The survey reveals the great interest that was taken in perennial ryegrass during the 18th and 19th centuries, and the efforts then made to improve this valuable grass ; also the diversity of opinions held as to the merits of Paceys ryegrass, and the probable cause or causes of the ultimate disappearance of this and other varieties evolved during that period. The growing antipathy apparent in the literature of the second half of the 18th century towards the common commercial ryegrass because of its stemmy nature and other undesirable characteristics later develops into a conflict of views as to the agricultural value of any kind of ryegrass. In this, however, the protagonists were at cross-purposes largely because of confusion and mistaken identity between the common ryegrass and types found in the best pastures. These controversies of the past are not without significance to present-day seed growing activities, and should reassure the seed merchant and seed grower of the importance and value of modern seed growing techniques and the need of supervised seed growing schemes for the maintenance of quality and authenticity in pedigree strains of cross-pollinating species.

Mr. Beddows deserves our gratitude and thanks for having undertaken this study, and for the able way in which he has collated and presented in an easily readable form these gleanings from the past. Only a tireless researcher imbued with a real enthusiasm would embark on a self-imposed task of this magnitude. This is the first bulletin to be published by the Station on researches into the history of grasses of economic importance in British agriculture, and I look forward with much interest, and so I feel will many of his readers, to his next bulletin which will deal with the history of cocksfoot, timothy and meadow fescue, material for which is now in course of preparation and should be available for publication in the near future.

E. T. JONES.
Director.

WELSH PLANT BREEDING STATION,
ABERYSTWYTH. *December 3rd*, 1952.

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The literature on which this historical survey is based could not have been examined without the facilities provided by many libraries, especially the National Central Library and the libraries co-operating with it. I am most grateful to their staffs, and to the following who so readily helped me personally: Mr. K. W. Luckhurst, Secretary, and Miss M. L. Clark, Royal Society of Arts, London; The late Sir William Ll. Davies and staff, National Library of Wales, Aberystwyth; Mrs. N. A. Davies, Joint Library of the Commonwealth Bureau of Pastures and Field Crops and the Welsh Plant Breeding Station; Mr. Irvine Gray, Records Office, Gloucester; the late Capt. Gregory, Royal Agricultural Society of England, London; Mr. L. James, Secretary, Farmers' Club, London; Mr. W. J. Mayes, agent to the Sherborne and Windrush Estates Ltd., Sherborne, and Mr. Walter Tufnell of the Estate's Office; Mr. H. S. Marshall, Royal Botanic Gardens, Kew; Mr. S. Savage, Linnean Society, London; Dr. L. W. Sharp, University Library, Edinburgh; Mr. W. T. Stern, Royal Horticultural Society, London; Miss Way and Mr. D. H. Boalch, Rothamsted Experimental Station, and Mr. J. G. Yardley, M.B.E., Bath and West and Southern Counties Society, Bath.

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I. Perennial ryegrass—*Lolium perenne*

I. PERENNIAL RYEGRASS—LOLIUM PERENNE

Introduction

English names

L. perenne in the 17th and first half of the 18th centuries

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Late 18th and early 19th century ideas on institutions for instruction and experiment in agriculture

The Welsh Plant Breeding Station and grass breeding

Retrospect and prospect

PERENNIAL RYEGRASS—LOLIUM PERENNE[1]

Introduction

Perennial ryegrass was the first of the true grasses to be sown in a pure, or relatively pure, state by agriculturists. The earliest record we have of this is the report by Plot (1677), and it is evident that Ray-grass was by then fairly well known and its seed an article of commerce. It is therefore reasonable to suppose that ryegrass has been sown each year somewhere in England for at least 300 years.

It has been suggested that this ryegrass, like the clovers, was brought over from the Continent to England, but this interesting hypothesis receives no support from the available evidence.[2]

[1] Extension of a paper given before Section K at the Edinburgh meeting of the British Association on 10th August 1951.

[2] Dodoens' (1595) herbal was first written in Dutch, but translated into English from the French by Lyte. It has a good deal to say regarding *Iuray* or *Darnell*: "a vitious graine that cumbereth or annoieth corne especially wheate, and in his knottiestraw, blades, or leaves is like unto wheate, but his eares so differ both from wheate and rie eares, for they are divided into many small eares growing upon the sides at the top of the strawe, in the which small eares the seed is contained in proportion almost like wheate cornes, but much smaller, ... for the most part groweth amongst wheate, and sometimes it is also found amongst barley, especially in good lands, where a wheate hath growen before ".

It is difficult to believe that Dodoens who so carefully described *L. temulentum* (above) would not also have referred to our *L. perenne* had it been cultivated on the Continent in his day.

Bradley (1725) writes " We receiv'd the most profitable kind of Clover first from Flanders, ... ; but it is our general Way to sow it with some other Seed as *Barley*, or *Rye Grass*, or sometimes with both *Barley* and *Rye Grass*." This seems to imply that the Flemish farmers did not use ryegrass, and when his statement is read in conjunction with the notes which follow, the conclusion reached is that they did not then know of *L. perenne*.

Schrebers (1769) states that *L. perenne* grows throughout the whole of Europe. Its cultivation is mentioned in one country only, England, where " it has been cultivated for a long time as a fodder crop but it is hardly worth the trouble, since it is hard and not very nutritious ".

Loudon (1825) " The improvements which might be adopted from Great Britain by Flemish farmers, enumerated by Sir John Sinclair, entirely coincide with our views and we shall therefore barely enumerate them. They are . . . . . ryegrass to sow with red clover, ... and temporary pastures ". (Sinclair, 1815).

Hedin (1948) states that seeds of ryegrass, timothy and fowl meadow-grass (*Poa trivialis*) obtained from England were sown in Normandy from 1787.

Gasparin (1844) on the other hand states that a form of *Lolium* had been known in Languedoc, France, " from time immemorial ". This fact was not generally known because the people there were not given to writing (*Le midi ecrit peu*). He goes on to say that but for the introduction into Central Europe of the species from Italy he would have had to refer only to the ryegrass from England and to that grown in the neighbourhood of Nimes (Gard). This ryegrass was known locally as *Margol*, and the fields containing it *margolieres*, which "have nothing in common with the sown leys of the English."

Margol was not sown, it appeared and multiplied during the wheat break of the rotation, which consisted of lucerne, wheat, wheat, wheat, ryegrass. " It suffices for the soil to contain some grains of ryegrass from the first year of cereals." This ryegrass matured and shed its seeds before the wheat was harvested so that by the time the third crop is removed "the ground is covered with a dense growth of ryegrass (epais d'ivraie)." The ryegrass was cut for hay the following year, and is said to have given an average yield of 4,500 kilogrammes per hectare of dry hay [approx. 4000 lbs. per acre] and to give 11 to 12 hectolitres per hectare of seed [approx. 12 to 13 bushels per acre].

It has not been possible, up to the time of printing, to obtain a contemporary botanical description of *Margol*. From Gasparin's account it would appear to be a form akin to *L. rigidum*, which is today in use under the name of Wimmera ryegrass in the wheat-belt area of Victoria, Australia. They sow it once and then it continues to maintain itself from shed seed. (Jenkin, 1951).

We do not know when the potentialities of perennial ryegrass, as a plant for use in alternate husbandry, were first realized, nor where, nor by whom, it was first grown to give a seed crop.

In considering how this has come about, it is necessary to make one essential assumption—this is that *L. perenne* was naturalized in Britain by the sixteenth century. This is not considered unreasonable although it is supported by circumstantial evidence only. The supposition receives support from Jenkin (1951) who, on the basis of theoretical consideration, writes " I believe we are justified in believing that the species *Lolium perenne* is truly indigenous to Britain in the sense that it either originated here or else reached Britain by natural migration and quite independently of man's intervention."

Holding paddocks near a farm are usually highly fertile, and they therefore provide just the conditions required for perennial ryegrass to establish itself and become abundant. The present writer, therefore suggests the following possible sequence of events which could have led eventually to the practice of harvesting perennial ryegrass seed.

Let us assume that the herbage of a cow-pasture near a homestead grew away from the stock, and, as a result, the field was put-up for hay. As hay crops were generally cut rather late, the inflorescences would contain numerous seeds in various stages of development, and many of them would be viable. Much of the seed would ultimately be found on the hay-loft floor, and in this instance to consist of a high percentage of ryegrass. The bulk would contain relatively few weed species because these are not so plentiful in consistently grazed fertile pastures as in meadows.

This hay-loft seed would be sown at 3 - 5 bushels per acre, in the last cereal break of the rotation, and it could produce a plant which developed rapidly after the removal of the corn. The quality, purity and bulk of the seed sown would ensure a clean, almost single species stand. Good swards were not readily established, and our hypothetical example would be a matter of pride to the husbandmen, and of discussion among his neighbours.

The question of obtaining similar seed would almost certainly be broached, and the practice of changing seed was well established. A demand would thus be created, and in order to supply it, the old cow-pasture, and possibly others like it, and the new ley, might be put-up for hay in the following summer and cut late to provide the seed required. In this way a local trade in the seed of " red Darnel," or " Ray-grass" as it came to be called, would develop.

It will be seen later that such a tradition of seed production was in fact built up in Britain. Farmers in widely distributed districts grew the seed required for their own locality, but as time went on some areas became pre-eminent in this respect. The practice of taking seed in the first harvest-year of the ley became universal. The effect which this was said to have on the longevity of the plants from these seeds became a topic for considerable discussion.[3] The system has, however, persisted and it remains the method in use today in Northern Ireland, and in Ayrshire, Scotland.

Ryegrass has always been a subject of comment and controversy among farmers and agricultural writers. Its popularity has waxed and waned like the

[3] In the course of time it came to be realized by some agriculturists that the plants in the old pastures differed in several important respects from those derived from " cultivated " seed. For a discussion of these differences see later in this paper, and see Jenkin (1951) who in addition also considers the problem of their origin.

prosperity of agriculture itself. This is not to suggest that these trends were correlated, although it is true that alternate husbandry with its seeds-break was most extensively practised in times of prosperity.

The very abundance of the material relating to ryegrass in British agricultural literature has necessitated selection. But the authors represented here, and the extracts quoted, provide a fairly complete survey of the history of this species.

English names for L. perenne

The name Darnel was long used in something akin to a generic sense for ryegrass or *Lolium.*

In Gerarde's Herbal (1636), as amended by Johnson, there is a chapter which is headed " Of Darnell." In it the first species referred to is called *Lolium album,* White Darnel, and when Gerarde comes to the names by which it is known in various languages he says " in English, Darnell, or some Iuray and Raye,[4] and of some of the Latines *Triticum temulentum.*"

The second species he gives as *L. rubrum,* red Darnel, and this is our *L. perenne* L. The English names for *L. perenne* have been astonishingly varied and numerous, as will be seen from the following list, which may not be complete. The earliest known authority is given in each case :—

Red Darnel, or Great Darnel Grass (1636 Gerarde)
Ray or bennett-grass (1677 Plot)
Rey-grass (1716 Mortimer)
Rye Grass (1725 Bradley)
Rye or rey-grass (1726 Townsend)
Rey-grass or bents (1759 North)
Perennial Darnel (1762 Stillingfleet)
Red perenne, Ray Grass, Rye Grass (1776 Withering)
Rae-grass (1793 Rev. A. Young)
Iver (1794 Fraser)
Perennial ryegrass (1804 anonymous)
Devonshire ray (1805 Billingsley)
Crap (1808 White)
Eaver (1811 Worgan)
Devonshire rye or Devonshire ever, or Peacey's rye grass (1812 Stevenson)
Heaver (1829 Jones and Kingston)

[4] The words ray, eaver and their variants are derived through the French *ivraie* (pronounced eevray), and ivre (pronounced eevr), from the Latin *ebriaca* meaning inebriated.

In the Linnean binomial for darnel (*Lolium temulentum*) the words mean *darnel which inebriates,* and it was described as *infelix lolium* by Pliny because of its characteristic effects when taken in food or in drink. It is because of this that the species has such a long history, for it was well known to the Greeks and the peoples of the Near East (it is the *tares* of the New Testament), and in ancient China. The Welsh word for tares is *efrau* (pronounced evrye, the ev as in ever ; the singular being *efr* = tare, darnel).

When perennial ryegrass came to be written about it was called *red darnel* and in French *ivraie vivace.* Thus the word *ivraei* became by transference applied to the " harmless " or red darnel, and it is so used in the English form " eaver" and " rye " grass.

L. perenne in the 17th and first half of the 18th centuries

Martyn (1792) was not able to find out how long ryegrass had been under cultivation. "Neither Gerarde (1597) nor his re-publisher Johnson (1636) nor Parkinson (1640), give the least hint of any use to which it is applied. None of the writers on husbandry in the last century whom I have now before me, as Sir Hugh Plat, Googe, Markham, Sir Richard Weston, Hartlib, Gabriel Plattes, Blith and Yarranton say a word in its commendation or insinuate that any particular species of grass was sown in laying down land."

He goes on to refer to Plot (1677) in whose book " The Natural History of Oxfordshire" is found the first record of perennial ryegrass as a herbage plant. Robert Plot, a Doctor of Laws, later became Keeper of the Ashmolean Museum and Professor of Chymistry in the University of Oxford (Plot 1686).

In the book on Oxfordshire he reports : " It was first sown (as I was told) in the Chiltern parts of Oxfordshire, and since brought nearer *Oxford* by one Mr. Eustace an ingenious husbandman of Islip, who though at first laught at, has been since followed even by those very persons that scorn'd his Experiment, it having precedence of all other *grasses*, ..."[5]

Ray (1686), according to Martyn, says it is sown in a few places, and that it is excellent for fatting bullocks. Morison and Bobart (1699), writing in Latin, state that it is found along roads, footpaths and in pastures. The seeds are gathered [*collecta*] and sown when the corn crop has become poor in order to produce a grassy sod. This grass, which is known to farmers under the name of Ray grass, provides an excellent food for sheep and other cattle.

Nourse (1700) is reported by Donaldson (1854) to say that " Pasture grounds are improved by being sown with grass seeds as clovers and sainfoin, which are highly commended. Ray-grass is a spiry, benty sort of grass, and thrives on a variety of soils, but not so much in vogue as sainfoin." While in Townsend (1726) we find : " Rye Grass or Rey Grass is sometimes sown by itself upon stiff clay Ground, and sometimes with one of the *Clovers* (*Clover-seed*, Dutch-*Clover* and *Trefoil*) in February or March."

There is frequent reference to what farmers had to say about ryegrass in Lisle's " Observations in husbandry " (1757). This book was, however, based on notes put together 44 years earlier. It records what Lisle, a landowner and magistrate, had seen and heard that interested him on his own estate, and on his travels in Hampshire and the neighbouring counties at the turn of the century.

Lisle records that an eighteen acre crop of ryegrass on the farm of a Mr. Lawrence of Upcern in Dorset, gave seed worth twenty pounds. This seed was sold at 22 pence and 2 shillings per bushel, but no reason is given for the two prices. The hay left after threshing the seed was found to be more palatable than oat straw, for cattle having access to a rick of each did not touch the oat straw, but they "made such a hole into the ryegrass hay reek that it was ready to fall." He said that if the ryegrass " was mowed green and not for the lucre of the seed it was an excellent food for cattle." A Mr. Oxenbridge showed Lisle his ryegrass hay which was mowed when in flower, and was regarded "as his choicest fodder for his sheep." Lisle also thought it was very fine hay.

There was general agreement among farmers that ryegrass would maintain as many cattle per acre as hop clover (*Medicago lupulina*), but they did not

[5] Plot's account of the properties and the place of ray-grass in alternate husbandry in Oxfordshire is given in full as Appendix C. (page 61).

find it improved the land for corn like the latter. The views of Dr. Woodward, a physiologist of the time, on the reasons why ryegrass and hop clover differ in their effect on the following corn crop are of considerable interest. "The ryegrass roots being very like the roots of oats, barley and wheat, may feed on the same salts of the earth that the roots of those grains do." Their fibrous roots are contrasted with the carrot-like roots of the hop and broad clover which "neither gird the earth together, nor feed on the same juices . . . the roots of ryegrass are sweet and juicy, promising nothing of strong concocted salts, whereas the roots of clover are very hot and tart, which argues that they have drawn them and digested many nitrous and salt parts, which, when rotten in the earth, may well impregnate it. Quaere (*sic*) about the roots of peas halm and the halm of vetches, for I must suspect these roots to communicate to the earth the same benefit that clover roots do, and a greater benefit than only by mellowing it."

According to Mortimer (1716) ryegrass will last up to seven or eight years on certain lands. Some farmers mowed it for hay and obtained about five quarters of seed per acre, which was sold about London for from half a crown to three shillings and sixpence a bushel. "If the rey-grass seed be cut something green, it makes the best hay and the seed will grow, but not so well as if ripe; but you must take care if the seed is newly threshed that it does not lie thick because it will heat."

He makes the claim that ryegrass will endure summer droughts and winter frosts, is the best of winter foods and the first to start growth in the spring, while "the shorter it is fed the better." In cases where the ryegrass stand became thin, it was oversown with a bushel of seed per acre, and then rolled only. This apparently made the sward thick, and he adds that "rey-grass will kill thistles."

Mackintosh (1724), writing in Scotland on re-seeding arable land, advocates not less than 20 lb. of either red clover or "Hope clover" if sown alone, but if mixed with ryegrass, 12 lb. of clover with 3 bushels ryegrass, or if only the latter, then 5 bushels per acre was to be allowed. Where, however, a field was to be laid down for a number of years for either hay or pasture "then it would be very proper with all or any of the above-mentioned grass seed, to sow the seeds of good upland or lay hay, ... as also the seed of white clover and narrow leaf planting [*Plantago lanceolata*] which last is known among the children by the name of head-men . . ." The reason he gives for this practice is that the clover and ryegrass generally go out in 3 or 4 years, leaving the field very bare, or with a "thin scanty crop of ryegrass, and so continues for some 2 or 3 years, till the pasturing of cattle or the application of some manure give the ryegrass new strength, or brings up such grasses as are natural to the soil." The addition of natural grasses enables these to replace the clover and ryegrass "as they decay."

Mackintosh must have been one of the first to advocate the production of seed by the farmer from pure stands. He says "it will be proper to sow each of them by themselves in some portion of ground, in proportion to the quantity he wants to have, because they do not all ripen at one time." Fitness to harvest could be judged by rubbing the heads to see if the seed was full and firm. Ryegrass was to be left a day or two in the swath, and thrashed in the field on a dry day "upon boards laid upon a cloth." This is best for ryegrass as its seeds are apt to shed. This also holds for hop clover, but not for red and white clover,

which can be thrashed when seeds are required.

The Society of Arts first offered premiums for clean lucerne and white clover seed in 1761, and for clean grass seeds, including ryegrass, in 1762, which is 38 years after the publication of Mackintosh's book.

Edward Laurence (1727) provides a set of model covenants for farm leases. One of these stipulates that land converted into tillage must, in the spring following the third year, be sown down " with clover, rey-grass or other proper grass seeds as shall be thought most agreeable to the nature of the land." Later on he writes that those who have ploughed up " fresh pasture grounds in order to sew Woad, Weld and plant Madder for the Dyers use," must in the fourth year sow " natural hay seeds, or rye-grass and clover together. And to restore the riches that the aforesaid Woad, Weld, etc., may have taken from the pasture, the said tenants also are obliged by the new covenant to lay on 100 bushels of lime or 20 loads of dung upon every acre at the time of laying down the said grounds." On another occasion he recommends the sowing of three and a half bushels of ryegrass per acre if used alone, but if with clovers " which is generally thought best," then one bushel only of ryegrass and eight pounds of clover were to be sown.

The " common produce" of seeds per acre is given as about 30 bushels, with two or three loads of hay, and the " middle price" of the seed at half a crown per bushel.

The yield and price quoted was probably fairly general over the South of England. A contemporary (Bradley, 1725) discussing a six year old stand of ryegrass says " I saw it once cut for Hay but 'twas very coarse, and what I judge the Cattle would not like ; however the seed of it, when it was thrash'd might be worth about half a Crown a Bushel, and an *English* Acre of it might possibly bring about six and thirty Bushels of Seed, which at half a Crown *per* Bushel, will be worth four Pounds ten shillings, besides the Hay, and the Profit of feeding of Cattle afterwards, which may be worth near twice as much more."

Ryegrass had already reached the London shops, for Ellis (1733) gives a list of artificial grasses from " a shop bill that was given me where I bought some seeds in London." The seeds were " Trefoyle or nonsuch ; clover ; St. Foyn ; La Lucerne or Medic clover or Snail clover ; Ryegrass, and Low grass." In the text the latter is given as Cowgrass ; " the cowgrass is called cow clover or white clover . . . but lately introduced into the world under the ficticious name of cow grass . . . amongst our best husbandmen in Hertfordshire it is rejected as absolute honeysuckle seed . . . "

L. perenne in the second half of the 18th century, and its disrepute

The harvesting of seed from ryegrass had already become fairly general among farmers in England, and it was also practised to some extent in Wales. In 1790 the Cardiganshire Society for the Encouragement of Agriculture awarded a piece of plate to a landowner near Aberystwyth in respect of a crop of 161 bushels of clean marketable seed of ryegrass. (Cardiganshire 1790).

Some idea of the widely differing opinions held concerning perennial ryegrass may be obtained from the writings of the following authors. One of the soundest and most extensive of the earlier accounts of the culture and management of ryegrass is that of the Rev. Adam Dickson (1765-9) : respecting the antagonism to it he writes, " This grass has got this bad character perhaps more from the practice of the farmers than the nature of the grass ; and were

any of the other grasses treated in the manner that this kind is often treated, they would perhaps be found as great, if not greater, impoverishers of land than it is."

Arthur Young was not convinced that it was without virtue. In his "Tour through the North of England" (1771) he says "Ray grass has of late been much exploded, but fashion should never exclude the consideration of all fair circumstances." He then quotes the case of a field near Newport Pagnel in which clover mixed with a little raygrass was said to fatten an ox in the spring better than the natural grasses, "a circumstance that much deserves attention."

Anderson (1777) considered ryegrass to be an indifferent species for pasture, but in 1798 (Vol. 3, ed. 4.) he advocated its use for the improvement of waste land. The first corn crop was to be undersown with a seeds mixture consisting of 10 lb. white clover, 10 lb. yellow clover and 2 bushels of clean ryegrass per acre. On the next page under the heading *Rye-grass recommended*, Anderson writes: "I am also aware of the aversion that some persons have against ryegrass; but as I am satisfied, from long experience and accurate observation, that there is no sufficient foundation for this prejudice, I should think I betrayed the trust reposed in me, did I allow it to influence me on the present occasion . . ."

James Adam (1789) suggests that ryegrass ran "all to stalk," and so made grazing difficult for cattle "by tickling their nostrils, that nothing but want of better grazing, will compel them to eat the young grass which shoots up between these withered stems." He suggests that if they were cut for hay, it would not only provide winter feed for the working horses (and so repay the cost), but also provide conditions more favourable to the growth of the aftermath.

He shows that there is a relationship between fertility and persistency, and gives his reasons. Perhaps we ought to read shoots where he writes roots. "It seldom lasts above three or four years as it is commonly managed: but if the nature of its roots and their sending forth fibres from their joints be considered, it may surely be kept alive many years longer, by dunging and other dressings. This would make its roots tiller and meet; to the utter suppression and destruction of all weeds, even couch-grass not excepted."

Marshall (1789) says "instead of a *gallon of clean ryegrass*, a *sackful of rubbish* be sown . . . its evil effects cannot be said to be owing to the nature of the plant, but to a want of judgment in the growers of it. Under proper management it can do no harm; it can *smother* nothing but the bones of the cattle that eat it, nor exhaust anything but the pockets of their purchasers . . . I have been induced to say more on this subject and to express my ideas in stronger language, as some of the leading men of this district (Vale of Gloucester) are *afraid* to cultivate ryegrass and one more particularly whose management is deservedly looked up to, is an open enemy to it. All I have to say farther on the subject is that *I verily believe* I have no undue affection for any particular species of grass. My leading principle of conduct . . . is to stand with all my strength against FALSE-GROUNDED PARTIALITIES . . ."

Parkinson (1798) wrote "Ryegrass is a sort of grass I am very partial to: but no doubt I shall find many differ with me in opinion. However, I by experience know that one acre sown for sheep with ryegrass, white clover and trefoil will maintain a proportion of three to two sheep more than will any other kind of grass or mixture of grasses I know of. When I say of *three to two* I mean for twelve months, as ryegrass is both the earliest and the latest. In

spring it cannot be eaten too early, if the animals can but live upon it, for if it is suffered to spindle it will be exhausted before spring, or best season is over: on the contrary, if eaten close it will keep continually springing, as cabbages sprout after being cut, and the more it is eaten the more it will grow." He continues " at the time when the ryegrass is so very luxuriant the white clover is totally concealed in the ground, but the trefoil makes some small appearance, and when the ryegrass has done all that can be expected, the trefoil springs up and becomes food for the sheep, after which the white clover succeeds, and in like manner supplies the sheep or cattle. When the white clover is done, the ryegrass again springs up and continues growing all winter if the weather is tolerably open. At all events it will grow if any grass can *grow*."

Parkinson adds " If you intend it for meadow and sow one sack upon an acre it will be like throwing the seeds of the trefoil and white clover away, as rye-grass by springing so early and by smothering the land prevents the others from growing to any degree of perfection." He mentions that the seed of rye-grass was rarely found pure, but was generally a mixture of " noxious roots" and was for this reason generally disliked.

The county reports to the Board of Agriculture contain many references to the failings of ryegrass. According to Young (1809) " the very intelligent farmers from Culham to Dorchester: they sow no ray-grass or at least very few of them. When once they have sown it they cannot get rid of it for years, and conceive that wheat will never be found so good where it is sown as where there is none. At Enstone, Westcot, Barton, etc., the most experienced men consider ray-grass as very far from an ameliorating crop: and an old and sensible labourer's expression was " It is as bad and sucking as oats "!

That a soil in good heart was a necessary condition for success in making a ley was known to some at least. Thus Mackintosh (1724) wrote of the disappointment met with in Scotland in seeding down arable land to grass, and the reason for it. He says " we so continue to labour our grounds for corn till they be reduced to a state of almost absolute sterility, which may be said of ground when it does render three-fold, and then such as incline to sow grass seeds begin to employ these grounds for that purpose, whereas in England ground is unfit to be continued longer in tillage when under less than five-fold . . . . *one* for seed and labour, *one* to labourer's family and servants, *one* to the master or landlord, *one* to accidents of tear and wear, death of cattle, loss of market, etc., and *one* for farmer's profit."

Leatham (1794) puts the matter succinctly, " it is to no purpose to sow land not in condition, this attention is even more material than the choice of seed."

The short-lived nature of the plant types derived from the seed sown was frequently blamed for the poor swards. But there was more in it than this, for the condition of the seeds themselves often militated against success. There are frequent warnings in the literature against allowing the seeds to overheat during and after harvesting. Then again the too early harvesting of the hay or seed crop caused the caryopses to be poorly developed, so that such seed either failed to germinate or only partially did so, and produced but weak seedlings. So, in spite of what had been written in favour of perennial rye-grass by some authors, there is ample evidence that the opinion of many, if not of the majority of farmers, was adverse. This ultimately led to a consideration of other species.

Interest in the Natural Grasses

The short life of the artificial grasses, and especially of ryegrass, turned attention to the persisting " natural " grasses found in the old pastures.

The earliest and most influential advocate of their use, and collection in a pure state, was Benjamin Stillingfleet. He was an admirer of the work of Linnaeus and his school, especially in its agricultural aspects, and in consequence he translated some of their dissertations from *Amaenitates Academicae.* These he published in 1759 as " Miscellaneous tracts relating to Natural History, Husbandry and Physick". In the second edition in 1762 he added his own " observations on grasses, which with the *Flora Anglica* (1762) by his friend William Hudson, and the works of Curtis (1790), Swayne (1790) and others, prepared the way for the better recognition and use of our grass species.

Stillingfleet wrote " the farmer for want of distinguishing and selecting grasses for seed fills his pastures either with weeds or bad or improper grasses." He apparently frequently employed children of ten or eleven years of age to collect seeds of various grasses, which they did " without making any mistakes after I had once shown them the sorts I wanted".

The general situation at this period, and the dilemma facing the farmer because of the rapid deterioration of his leys is well put by Adam (1789). " There has hitherto been so complete an ignorance, and want of attention to the use of proper grass seeds, for laying down land, that the farmer has had no other resource, but in red and white clover, and in rye-grass : he never dreamed of collecting any other seeds for this purpose, and could find none other in the seed-shops. When therefore, he deviated from this trodden path, he did what was infinitely worse ; for, by collecting the seeds of grass from his own hay-loft, or that of his neighbour, he doubtless collected a greater variety of seeds, but a very dangerous one, in which those of weeds made no inconsiderable proportion."

" To those husbandmen, therefore, who have no opportunity, or industry, to increase their resources, I must still recommend the red and white clover, the common trefoil or hopclover ; the burnet, and the rye-grass, as the only seeds they can properly use ; and if their land be tolerably dry and in good condition, they will not fail, with the accession of other natural grasses to form a sward in the course of a few years."

Lawrence (1800) informs his readers that Messrs. Gibbs, seedsmen to the Board of Agriculture, had " for some years taken great and meritorious pains to collect seeds, by hand, in various parts of the country most remarked for the production of the best grasses."

Premiums for Grass Seeds

The London Society for the Encouragement of Arts, Manufactures and Commerce (now the Royal Society of Arts) was established in 1754. It did much through its committee for agriculture to encourage the continuance and extension of the collection and growing of pure seeds of agriculturally useful species. This aspect of their activities has been reviewed by Fussell (1951). The Society granted premiums for the best collections and yields of the following natural grasses : meadow foxtail, meadow fescue, the fine-leaved fescues, crested dogstail, *Poa* spp., sweet vernal grass and yellow oat grass.

It was recognised that much of the seed offered for sale was harvested from hay meadows. Therefore, when on 7th April, 1762,[6] the Society considered the " advertisement " of premiums they included seeds threshed from field crops as well as small lots harvested by hand. An amendment to this enabled ryegrass to be entered in either section. It is evident, therefore, that the Society had an open mind regarding the value of perennial ryegrass. This meeting accepted a further motion adding to the advertisement the following *nota bene* : " that a few plants of each kind of grass, with the seed growing on them, must be sent with every quantity of the seed". This was done because at first " they did not think proper to specify the names of the grasses required, as such grasses have various names in different parts of the kingdom, but they reserved the right of excluding all such as should not be really valuable and useful".

Up to the end of the 18th century the word " grass " was in general use to connote all plants providing food for " cattle," that is, for all farm stock. This usage and the fact that the words " artificial grasses " included such different plants as sainfoin, lucerne, red clover, burnet, white clover, ryegrass, spurrey, ribgrass, etc., presented difficulties to those drawing up the advertisements of premiums. They had therefore to restrict the use of the word grass to members of the Gramineae. But the position of ryegrass was somewhat anomalous, because it was always included among the " foreign grasses," such as sainfoin and lucerne. Therefore, we find Dossie (1768), one of the leaders of the Society's Agricultural Committee, writing " there is indeed one species of true grass that was before collected, and sown with the foreign grasses, which is the kind called ryegrass, but the Society took care to except (*sic*) it specially in their advertisements".

In the 1802 list of premiums for natural grasses the ryegrass is replaced by timothy.

Cocksfoot was not brought in until 1817, when perennial ryegrass was restored to the list, which continued unchanged until the 1823-24 season. In 1824-25 the new status attained by ryegrass was recognised by the award of a special silver medal. The seed submitted by the improver claiming this award had to be " from a stock originally of his own selection which shall possess the properties of coming to a sward in less time than varieties hitherto cultivated, and which shall be permanent, more abundant, of better quality and as early as the most forward of varieties usually sown. Five pounds of the seed and specimen of entire plant to be forwarded with the communication".

The medal was awarded in 1825 to George Whitworth, of Acre House, Caistor, Lincolnshire, and in 1826 to William Stickney, of Ridgmont, in the Holderness division of Yorkshire (Society of Arts, 1843). See Appendix E for the correspondence in connection with these awards.

W. Marshall and the idea of a persistent ryegrass

It will be appropriate at this point to inquire how it came about that the Society was able to envisage a ryegrass of the above type. In order to do this we must go back to 1789 when William Marshall published his " Rural

[6] It was at this meeting that Charles Linnaeus M.D. was elected a corresponding member. On August 4th of the same year a letter from Linnaeus regarding grasses was placed before the Society. A copy of this letter, which is in Latin, is preserved in the *Guard Book* for 1757—62.

Economy of Gloucestershire". In this he refers to the prevailing antipathy towards ryegrass, and then goes on to say that " hay seeds " were sown because ryegrass was thought to be " ruinous to the vale lands". Yet his own observations showed that the predominant herbage of the old grasslands of the vale was ryegrass.[7] He lists the species occurring in two swards " arranged agreeably to their degrees of frequency," and in each *Lolium perenne* comes first, followed by *Trifolium repens*. Marshall was probably the first grassland ecologist.

Regarding the " hams " or commons, he states that their herbage in the spring, and more particularly in the autumn, was one continuous mat of ryegrass and white clover with some crested dogstail. " How easy to collect the *native species* which abounds on the old grasslands, and thus raise a new variety[8] adapted on a certainty to the vale land . . . . it only wants a little exertion . . . . . "

The Cotswold hill farmers were said to esteem ryegrass next to sainfoin. They also mowed their hay at a stage of high nutritive value. Thus in 1788 they " began cutting their ray-grass leys about 22nd of May, while the spikes were yet shooting". This suggests that the ryegrass must have been a fairly late heading type.

According to Marshall " men of observation assert that there are two species of ryegrass now in cultivation in this district, the one annual and the other perennial. The former, the ordinary sort, which is sold at the shops, the latter raised on these hills. This is a strong evidence of the advantage to be

[7] In volume II (*ibid.*) Marshall discusses the herbage of North Wiltshire. He says that in July he " could perceive no material difference with respect to the *species* of herbage, between this district and the vales of Gloucestershire. The *ray-grass*, *dogstail* and *white trefoil* [=white clover] were then the prevailing herbage of the pasture grounds ".

[8] Sir John Sinclair when elected President of the Board of Agriculture for the second time on March 25th 1806, suggested in his speech that attention ought to be paid to the improvement of cereals and other produce by applying the principles of selection as in the case of the breeding of live stock (Clarke, 1898).

There is a more modern sound in the suggestion by Loudon (1825) that " new and excellent varieties of many of the grasses, especially those used or fit to be used in the convertible husbandry, might no doubt be obtained by selection and cross breeding, and it is much to be wished that this were attempted by cultivators ".

The first attempt at systematic crossing in the grasses seems to have been that by John Garton of Messrs. Gartons of Newton-le-Willows, Lancashire (M'Alpine, 1898). A brother had been working with cereals but it was John Garton " who conceived and is engaged in carrying out the idea of extending and applying the same methods to forage plants—the idea of developing the clovers and the grasses on the same lines as the grain crops. His handiwork has not been barren, for already many new and promising types of forage plants are being born and in course of evolution ". In 1893 he picked out " those species and varieties which stand in highest esteem, and those which he considered most worthy and most capable of improvement ". The eleven species selected consisted of *Lolium italicum*, *L. perenne* and nine *Festuca* spp. The two ryegrasses were crossed with each other and with the fescues in order " to instil (into the ryegrasses) the strongest possible tendency and power to vary and sport . . . . ."

The New Zealand Grasslands Division, Palmerston North, has distributed a hybrid strain derived from crosses between perennial and Italian ryegrasses. This strain is referred to as " Short-rotation ryegrass ", or, briefly, as " H.1 ". (Corkill, 1945).

expected from the cultivation of the *native* raygrass of a country[9] (*sic*). And every country ought, without loss of time, to set about a work which is so easy and promises so much advantage."

William Peacey of Northleach, Gloucestershire[10]

A farmer " on these hills " was doing just this and at that time. He was a William Peacey, and although Marshall refers to him as a well-known farmer,[11] and as one who had found a remedy for " staggers " in horses,[12] he makes no mention of him as a grower of ryegrass seed. Pacey farmed 1,015 acres at Northleach in Gloucestershire,[13] as a tenant of Lord Sherborne, who was a brother-in-law of Coke of Holkham, Norfolk.

There is no evidence that prior to Pacey and Marshall there was any awareness that plants from within the same species, taken from different habitats, might vary in type and in agricultural usefulness. Pacey, as a Cotswold farmer, had probably realised that ryegrasses varied before Marshall visited the area. That this was so is suggested by the fact that in May, 1776, the latter wrote " ryegrass is a filthy weed unfit to be introduced into arable land "

[9] The word country was frequently used at this period in the sense of county or locality. Thus Marshall (1789) discussing the very dry weather of 1788 in Gloucestershire says . . . . " in the middle of October while the lands of this country were so dry that they could not with any propriety be worked for wheat, and while even in Herefordshire farmers were breaking the clots with beetles, the farmers of Wales, not twenty miles distant, had not been able to put a plow into the ground for near a month, owing to the excessive wetness of the season! "

Hugh Davies (1813) in the preface to his book on the native plants of the Isle of Anglesey, refers to the latter as " the country which gave me birth and education ". Again with regard to *L. perenne* he writes " It sports in more numerous and strange forms in this country than I have ever seen it in any other ".

[10] His name is now written Pacey, but the Sherborne Estate muniments show that he always signed it *Peacey*.

[11] In the " prefatory observations " to Vol. II, Marshall (1789) claims that his account of Cotswold farming was approved by those best qualified to judge. He names two persons, one of whom was " Mr. Peacey of Northleach, a man whose superior management has spread his name and character over *this* district *at least* ". (In 1787 Pacey was awarded a piece of plate, value ten guineas, from the Bath and West of England Society, being the premium for 130 acres of sainfoin).

He is reported by Marshall to be one of the few good graziers on the Cotswolds. He used " to buy in large Welch bullocks, at Glocester, in autumn and winter. He gives them the run of the strawyard the first winter ; and summers them on raygrass and clover leys,—as *companions* to his fatting sheep,—to eat off the bents of raygrass ; and thereby not only to give the sheep a freer better bite than they otherwise would have ; but at the same time turns to a valuable purpose that which would otherwise (if not swept of with the sithe) remain an encumberance to the surface. The ensuing winter, they are finished in stalls, with hay and secondary barley. A new, but an excellent practice ".

[12] Pacey, who kept about twenty horses, had been troubled by losses due to staggers. He was advised to keep a he-goat in the stable, and from that time his horses remained healthy, until the goat died. A new he-goat restored the situation, and this evidence apparently convinced the sceptical Marshall of the efficacy of the remedy.

[13] He has also been variously referred to as " Mr. Peacey of Devonshire " (Anon. 1807) ; " a cultivator in the higher districts of Staffordshire " (Wilson, 1847-56) ; " an enlightened agriculturist in the supper parts of this county (Staffordshire) " (Sowerby and Johnson, 1857-61), and as " Mr. Pacey of North Leach, Wiltshire " (Lawson's *Agrostographia*, 6th ed. 1877).

The quotation from Sowerby and Johnson was taken by them from Withering (1818) who gives it in a footnote as a communication sent by Swayne. The Staffordshire in brackets was an additon by Sowerby and Johnson. Swayne was vicar of Pucklechurch in south Gloucestershire. It has not been possible to trace the source of Wilson's information.

(Marshall, 1778). But the fixing of priority is of no great importance. It is clear from the Gloucestershire report (Marshall, 1789) that the difference and its significance were fully appreciated, and it is to Marshall that credit must go for first making this known to a wider public, while Pacey was the first to exploit on any scale the market for seed of this later flowering, more leafy and more persistent form of *Lolium perenne*.

It is to these two men, therefore, that credit must be given for creating in the minds of the agriculturists of the early 19th century the consciousness of the potentialities latent in indigenous ryegrass. It is not surprising, therefore, that Pacey also began to pay attention to similar possibilities in cocksfoot. (See Appendix, page 64).

The earliest reference to the new ryegrass would appear to be that found in the minutes of a committee of the Bath and West of England Society held on 9th December, 1793. In these, as Item 11, the Secretary wrote : " Mr. Pacey having reported that he is in expectation of successfully propagating a specially valuable ryegrass which he believes has been but little known, he is requested to give attention to that subject, and, if successful, to take measures for extending the benefit as to him shall appear most effectual".

Pacey was one of the first farmers to become a member of the Bath Society, having been elected in 1783, and he was on the committee for agriculture concerned with drawing up and awarding premiums for grasses. From the phrasing of the above Minute there would seem to have been little enthusiasm for ryegrass among his colleagues. Their chief concern was " with those grasses known to be excellent in pastures, and whose seed is not commonly to be bought in shops," not realising that Pacey's ryegrass fulfilled these requirements admirably.

The new ryegrass was next referred to at a meeting of this same committee two years later, on 8th December, 1795, when Pacey was present. The Minutes record that " Mr. Peacey's ryegrass was generally reported to be growing in esteem". There is nothing more ; he must have been a modest man.

Further information about what was in its way an agricultural revolution is given by Turner (1794) in his survey of Gloucestershire farming, and by Davis (1794) in his report on the county of Oxford. Both surveys prepared under the auspices of the recently formed Society, the Board of Agriculture.[14] Turner

[14] The government department of this name came into being by virtue of the *Board of Agriculture Act*, 1889. The similarity in the names has led to misunderstanding about the character of the earlier body (1793-1822), but this is made clear by Clarke (1898) in the following paragraph. " From what has been stated, it will be seen—and it is important to bear this in mind—that the Board was not a Government Department according to our modern acceptation of the term, but was essentially a Society for the encouragement of agriculture, as the Royal Society of London is for the encouragement of general science. Like that Society, the Board was supported by Parliamentary funds, but the Government of the day had only a limited control over its affairs, through the *ex-officio* Members, and a transference of political power from one party to another did not necessarily affect its policy or administration. The Board exercised none of the executive functions of Government ".

Floud (1927) also makes the same point : " It was a Society founded by Royal Charter and supported by an annual grant from the Exchequer, and its true successor is the Royal Agricultural Society of England (1838 incorporated by Royal Charter 1840) rather than the Ministry of Agriculture ".

In the British Museum Library Index under Board of Agriculture we find " (For the learned society formed in 1793) see . . . . ."

states that a " very valuable sort of ray grass which has been cultivated for 20 years past by Mr. Peacey of Northleach deserves particular mention". This suggests that the Minute of the 9th December, 1793, quoted above, is something of an understatement, for if this statement is true then Pacey had been growing his strain since about 1774. His " expectation " must therefore have become reality before 1793 since Davis states " 50 quarters have been sent for in one order in 1792, when the whole that was raised that year did not exceed 16 quarters". Even Turner's 20 years may not really have been an exaggeration, since to quote Davis[15] again, " It first attracted his notice by continuing amongst sainfoin which had stood seven years ; the seed was, therefore, first selected from this sort and from time to time multiplied. . . . . " This sentence could quite reasonably cover a period of from 10 to 15 years.

According to Turner, " it has not been a general practice with the farmers on these hills to raise their grass seed ; the deficiency of natural pastures and the large flocks of sheep kept making the lays valuable both for hay and pasture ; this has occasioned rather a scarcity of seeds of late years and has been the means of introducing very inferior sorts from other countries (*sic*) of which some proved strictly annual, producing a tolerable crop the first year, but dying away the following winter ; whilst that of longer duration has been found to be very unproductive, particularly all the latter part of the season". The losses incurred as a result of sowing seed of these annual and biennial forms made farmers more careful in their choice of seed, and caused the price of reliable seed to be greatly advanced. Turner goes on to say that " Peacey seeded an unusual quantity last year [1793 ?] to answer the demand which he foresaw he should have for it. It is already engaged at the advanced price of half a guinea per bushel, which price [four or five times the usual] was fixed on it by some gentleman who had experienced its value, and thought it would not only properly reward the attention which had preserved so valuable a grass, but be the means of making it more generally known, and encouraging the culture of it to the exclusion of all the inferior sorts". We have here what is probably the earliest reference to an agricultural price-fixing committee.

Lawrence (1800) refers to the grasses selected by Messrs. Gibbs (Half Moon Street, Piccadilly), " as fittest for laying down pastures in general, in consequence of directions received from the ' Board of Agriculture,' to whom Messrs. Gibbs were seedsmen". He comments on " a new variety of Rye-grass ; the same, I suppose, which bears so high a character in Gloucestershire."

Rudge (1807), in his report on the Agriculture of Gloucestershire, says " the farmers of the district (Cotswolds) are excelled by none in the management of this useful grass. The sort lately much esteemed is that which takes its name from the person who paid particular attention to the collection of it, at least in a larger quantity than any other—Peacey's ray-grass. It was first selected from the finest meadows in the vallies of the Cotswolds, and by repeated sowings a sufficient quantity of seeds was raised for himself and neighbours. Opinions differ as to its superiority over the common raygrass, though its extensive use would seem to justify the claim".

The evidence at present available suggests that Pacey gave up the tenancy of his farm at the turn of the century, and there is nothing to show that seed of his strain of ryegrass continued to be raised at Northleach after he left.

[15] Davis's account of Pacey's ryegrass and its origin is given in full in Appendix D. (page 63).

I shall come back to this question of variability, but Pacey's ryegrass as first released must have been exceptionally good, for his name has connoted quality ever since. The custom of combining his name in a descriptive sense along with the words perennial ryegrass is, however, a practice which should now be discontinued. The surname in this context lost its significance long ago.

John French of Lampits, Lanarkshire

While it is probably true to say that Pacey was the first to produce seed of a persistent leafy strain of ryegrass, yet John French, a farmer of Lampits, Carnwath, near Carstairs, Lanarkshire, must have been a close second.

The history of this strain is given by a member of the Eddlestone Farmers' Club (Anon. 1804) in a letter to the Farmers' Magazine dated 16th April, 1804. Apparently a Mr. White, a merchant from Carnwath, visited Lampits in 1791 and there saw a patch of perennial ryegrass in a neglected part of the garden which has been laid out in grass some 18 years before, i.e., about 1773. " So this grass must have been of the true perennial kind . . . it was carefully preserved, and from an original handful came at last to be raised in quantity to supply the demand of the market, and is now in such plenty as to have been sold this spring (1804) at 12 shillings per boll." Farmer French was a pioneer in that he maintained a source of foundation seed by sowing out the broad walks in his garden with the strain.

George Sinclair, the first scientific agrostologist

The first comprehensive study of the grasses[16] was carried out at Woburn by George Sinclair, gardener to the Duke of Bedford ; the results were first published in the folio edition of *Hortus Gramineus Woburnensis* in 1816, and also in subsequent editions without the herbarium specimens.

A large collection of seeds and plants had been brought together at Woburn Abbey, and these were sown or planted in beds of 4 ft. × 4 ft. in which the local soil was replaced by soils appropriate to each species. Sinclair's idea was " to obtain a clear and satisfactory knowledge, founded on facts, of the various properties, habits and comparative value of each distinct species or variety." The produce was cut and weighed,[17] and notes made on the season of optimum development, time of flowering, seed ripening as well as on growth habits. The soils and plants were chemically analysed, using the methods recommended by Sir Humphrey Davy. Sinclair was, therefore, the first to attempt a scientific evaluation of the worth of the various herbage species.

In so far as perennial ryegrass was concerned the plan of the plots, included in the first edition, shows only two types, *Lolium perenne* and *L. perenne* var. *Russelliana*, but in the text Sinclair mentions a number of varieties. In the

[16] Arthur Young in Volume I of his tour through the North of England (1771) reports that : " In the town of Wooburn I had the satisfaction of meeting with a curiosity in agriculture, a most accurate experiment ground, in which many kinds of grasses are tried with a neatness that must please every spectator. Mr. Bramstone is the owner, and certainly from the variety of his trials must be very understanding in the nature of separated grasses and very attentive to their culture ". Brief notes are given of the species seen but the ryegrasses are not mentioned.

[17] Sinclair decided against animal feeding trials because of variations in quality of the same food at different times, differential response of breeds and of individuals within breeds to equal amounts of the same food, and the large number of cattle required " at least 400 of the same breed."

third edition (1826) he states that a Mr. Whitworth of Acre House, Caistor, Lincolnshire, had 60 varieties of *L. perenne*. This was in the year 1823. Apparently only a few of these had been tested, but Whitworth did issue one strain of agricultural value. Of the various strains mentioned, five were on the market and recognised as superior to the ordinary ryegrass. These were Pacey's, Whitworth's, Stickney's, Dixon's and Ruck's.

Sinclair also refers to a Mr. Neill of Mansfield who sent him six varieties of ryegrass, one of which proved to be "identical with Stickney's grass and another proved to be the same with the Russell ryegrass. Neill had first collected the seeds of these from rich pastures, and afterwards by cultivating them in his garden he obtained seed sufficient for farm practice." Sinclair's is the first and apparently the only reference in the literature to Neill.

In a footnote Sinclair quotes the opinion of a noted agriculturist, Francis Blaikie, estate agent to Coke of Holkham, 1813-32 that the Dixon and Ruck strains were an improvement on Pacey's. He further adds that Church-bennet or church-bent grass, used in some parts of Berkshire, according to the Rev. C. Lord, "was an excellent variety of ryegrass."

Further information on the relative merits of the new strains is provided in the interesting and comprehensive "Encyclopaedia of Agriculture" by Loudon which went through many editions between 1825 and 1884. In the 1825 edition seven strains are mentioned, and of these Pacey's and Russell's are considered best. No reference is made to Dixon's or Ruck's strains.

Lawson's of Edinburgh

Peter Lawson and Son, seedsmen to the Highland and Agricultural Society of Scotland, were pioneers in that they not only provided farmers with descriptions of agricultural crops, but also prescribed seeds mixtures to meet the requirements of alternate husbandry, permanent pastures, lawns, etc.

Messrs. Drummond of Stirling who set up the first agricultural museum, suggested to Lawsons that they should do the same at Edinburgh. This they did in 1833 with immediate and continuing success. The report on their museum published as "The Agriculturists' Manual" occupied 430 pages (Lawson, 1836). The Manual contains an account of the species and varieties of agricultural plants cultivated in Europe, or which could be advantageously adopted in this country.

The gramineous herbage and forage plants were set out "so as to follow each other as much as possible, according to their relative value, or the estimation in which they are generally held by cultivators in this country, commencing with those sorts which are most prized." Pride of place is given to *Lolium perenne*, common ryegrass, because of its adaptability, reliability as a seed producer, and . . . "the fibrous structure of its roots which fit it in an eminent degree for alternate husbandry."

The varieties described are the Common or Scotch perennial ryegrass; Annual; Whitworth's; Pacey's; Russell's; Molle's; Stickney's; Pollexfen's; Devonshire evergreen (commonly called Devon Evers); Spreading ryegrass (*L. stoloniferum*) (seeds of which came from Germany) and Thick-stalked ryegrass (received from Vilmorin and Co., Paris as *L. grossum*).

In 1842 Lawsons published their *Agrostographia*, which was an extension of that part of the Manual dealing with forage plants. It also contained a chapter on the dates of the introduction and cultivation of species and varieties

of crop plants. This handbook on herbage plants and seeds mixtures became so popular that six editions were issued, the last in 1877.

This work, and the firm who published it, exercised a considerable influence on agricultural practice. How much so can be judged by the following quotation from a letter sent by Mr. J. Hunter of Chester in July 1896 to Mr. Robert Elliot of Clifton Park (Elliot 1908, p. 79) " . . . .and the teaching of this work was adopted by the seedsmen of Great Britain without question. At that time Lawsons supplied the English seedsmen with their grass seeds, and in fact controlled the trade in natural grasses. Indeed, it may be said that they not only supplied the other seedsmen with the seeds, but also with the ideas and information in reference to the subject. Thirty years ago (*c.* 1860) the writer was for three years warehouse manager in the grass seed department of Lawsons, and is consequently acquainted with the facts."

Three of the ryegrasses named in the Manual are absent from *Agrostographia*, but two are added, namely, fine-leaved and Rougheads. The sixth edition (1877) mentions only three sorts, Evergreen, Fine-leaved and Pacey's ryegrass. In neither publication is there any reference to the Lampits ryegrass.

Improved Varieties : the Position in the Mid-19th Century

The names of some of the improved ryegrasses continued to appear throughout the 19th century. There is, however, very little doubt that they had in reality ceased to exist as authentic strains by 1850, if not before.

In this connection the following quotation from Lawson (1836) regarding the ryegrasses is of significance : " but even the sorts which are most permanent in their characters, or such as are most capable of producing the same sort from seed, have become so much changed in habits and characters from the effects of continued culture upon different soils and under different circumstances, as no longer to retain any traces of the properties fro which they might have been originally distinguished." Again (*Ibid.* 1877) . . . " a sub-perennial beyond which title even the most permanent varieties of *L. perenne* have no claim."

Sturrock (1865) is equally definite : he says, " considerable quantities of ryegrass seeds are still sent out under the title of Pacey's perennial. The original Pacey's ryegrass was noted for its abundance of long and broad root leaves, sending up comparatively few culms topped by rather short spikes. In fact, just a *true perennial* ryegrass ; but the seeds now usually sent out under this name are simply selected parcels of fine regular-sized and generally heavy-weighted seed, growing plants the very reverse of the original Pacey's—a great abundance of bare stalks with large spikes and few or no root leaves at all. As for their Stickney's, Whitworth's, and others the writer has tried many samples procured from different quarters, and never could discover in the produce any superior properties or material difference worth notice when compared with the common ryegrass in cultivation."

The present writer (A.R.B.) reached a similar conclusion from different considerations :—

(*a*) There is no evidence to suggest that the work of selection and the multiplication of seed from new material was carried on after the death of any of the original improvers.

(*b*) There is nothing to indicate that there was an awareness of the mechanism of cross-fertilisation in this wind-pollinated species. They would, therefore, not be concerned to take any precautions to ensure isolation, and out-

crossing must have been considerable. This alone could quite easily account for the conflicting opinions expressed regarding the relative values of the different strains, and of the same strain at different times.

(*c*) The effect of contamination by " foreign" pollen would increase from generation to generation during seed multiplication.

(*d*) Contamination from within the field (volunteer rogues) and from mechanical admixture would hasten deterioration.

(*e*) The agricultural depression after the Napoleonic War was responsible for large acreages of land being allowed to tumble back into sward. Most farmers were unable, or unwilling, to face expenditure on grass seeds of any kind, let alone the dearer, improved sorts, and a falling off in demand would cause less seed to be grown.

The Introduction of a New Herbage Grass in 1831

The introduction of a new herbage plant, Italian ryegrass (*L. italicum*), was probably the most important single factor in the neglect of improved *L. perenne* strains. The first consignment of this grass was imported into Scotland from Hamburg by Messrs. Lawson of Edinburgh in 1831, and consisted of 160 bushels. The interest aroused by Italian ryegrass is clearly indicated by the fact that in 1851 they imported 25,000 bushels (Morton, 1856). During this period seed also began to be imported by other seed firms, while many farmers who had previously grown seed of the perennial, now turned to the new grass for which there was an increasing demand.

The Second Half of the 19th Century

In spite of this competition with Italian ryegrass, a few of the names still lingered in the seedsmen's catalogues. The following list shows the varieties quoted in 1860 and 1887 in Edinburgh, and their relative cost per lb. A ryegrass prefixed by the name Pacey still commanded a higher price :—

	1860	1887
Annual ryegrass	2½d.	2½d.
Common ,, ...	2d.	2½d.
Ayrhsire[18] ,, ...	2½d.	3d.
Stickney's ,, ...	2½d.	3d.
Pacey's ,, ...	3d.	3½d.

The improvement made in seed cleaning machinery during the second half of the 19th century led to improvements in the quality of the seeds sold. The extent of the need for this improvement became increasingly apparent from disclosures like those of Raynbird (1861) and from the reports of analyses made by the botanists to the Agricultural Society of England and the Scottish and Highland Agricultural Society. But it was probably due to Faunce de Laune (1882) more than to anyone else that the agricultural community became alive to the need for improving the quality of herbage seeds.

The credit of being the first to guarantee the purity, genuineness and germination of all farm seeds sold by them belongs to Messrs. James Hunter of

[18] The description " Ayrshire (produce of 2 years old grass) " was first used by Peter Lawson and Son in their list of Agricultural Seeds for March 1860.

Chester (Hunter 1885). They introduced their guarantee system in 1883; other firms followed suit, but the practice did not become obligatory until the passing of the Seeds Act in 1922.[19]

The need for some such control had long been a subject of discussion. A letter written to the "conductor" of the Farmers' Magazine by "a friend to improvement" (Letter, 1809) suggests the application to clover, ryegrass, etc. of laws similar to those regulating the flax seed trade. These laws "*inter alia*, direct that such certificates shall be delivered by the seller of that seed to the purchaser as may instruct the place of its growth, and the season in which it was produced, so that the latter might be guaranteed from loss or damage in case the seed should prove unsound, or of a different quality than described in the certificate delivered."

A recommendation that a central seed testing station be established under government auspices was put forward in 1901 by a departmental committee on agricultural seeds (Board of Agric. 1901).

The 1885 price list of Messrs. James Hunter states "perennial ryegrass (*Lolium perenne*) known as English ryegrass, Pacey's, Devonshire Evergreen, etc. . . . being short-lived should not be included in mixtures for permanent pastures. On very rich soils it may remain in the land 5 or 6 years, but on poorer soils it does not live more than 2 or 3 years." This implies that by this date the strains had all reverted to the ordinary type. The firm advised purchasers to buy their seed by the hundredweight, or the pound, and not by bushel weight, as the latter gave no indication of the real cost of the seeds.

About this time, again a period of depression, the laying down of land to permanent grass became an important objective. It was, however, a process fraught with difficulty, and success was infrequent.

The difficulties of reseeding are dealt with by Faunce de Laune[20] (1882)

[19] An Official Seed Testing Station had, however, been organised since 1917 in London by Mr. (now Sir) George Stapledon. The names of his associates are of interest in view of their subsequent close association with grasses and the problems relating to them: they were Mr. (now Professor) T. J. Jenkin, Miss K. Sampson, Mr. Robson and the late Professor S. P. Mercer.

[20] The present writer recently came across a very little known, but important, paper by Fream (1889) on "The facts about ryegrass as determined by experiment". The report of this paper and of the lively discussion which followed occupies 81 pages of the Transactions of the Surveyors Institution. It is almost a monograph on the agricultural value of perennial ryegrass as then understood. De Laune, to Fream's regret, was not present at either of the two meetings at which the subject was debated, but Carruthers put forward the anti-ryegrass views. What is interesting is that the protagonists on both sides were in the main justified in the stand they took. They were at cross-purposes because the ryegrass of commerce, and that found in the best old pastures, differed in degree rather than in kind. We should today think of them in terms of strain difference.

Although various speakers referred to the old writers none was apparently aware of the views expressed by Marshall (1789). A Mr. H. E. Raynbird came nearest the truth when he said: "the fact should not be lost sight of that there was ryegrass *and* ryegrass". He compared the short-lived "annual ryegrass of the North" and the "Hampshire ryegrass" with "another ryegrass in the south of England known as *evergreen ryegrass*, which was found in the meadows to be perennial like the fescue grass and the cocksfoot . . . . . ."

The same confusion is fairly common in the literature of the nineteenth century. Keith (1811) considered the non-perennial character of the *L. perenne* generally available to be due to "artificial cultivation long continued and injudiciously conducted, ...which derives confirmation from the superiority of Mr. Pacey's ray-grass, which is nothing more than a restoration of the species effected by collecting seed from the plant in its native state".

and the following quotation from his paper is revealing: "unfortunately for owners and occupiers of land the grossest ignorance prevails about grasses. To many landowners and farmers almost every herb that is green is considered to be grass, hence the ordinary circumspection used in purchasing grain crop seeds has not been exercised in the case of grass seeds. It is generally, I might almost say invariably, alleged, and truly so, that newly-formed pastures have been found to deteriorate greatly after the first two or three years. The grasses most pernicious to newly-formed pastures are, first and principally, ryegrass in all its varieties and Yorkshire fog . . . all ryegrasses, or nearly all, die after once seeding."

It is interesting to note that de Laune (1882) regarded Sinclair's *Hortus Gramineus Woburnensis* (1816) as "the best book, in my judgement, for practical knowledge respecting the cultivation of grass." In this connection it is apposite to quote part of Hunter's letter to Elliot (*loc. cit.*) ". . . .but it is a pity he (Lawson) did not revert to Sinclair's teaching as to the limited use of ryegrass as soon as the other grasses could be freely obtained. If Mr. de Laune had not gone back to Sinclair to find out the truth I fear we should still have been pretty much where we were twenty years ago" (1876).

The Early 20th Century

The situation described above continued without much change into the early part of the present century. The realization that there was a great need for information on crop plants led the government to appoint a number of advisory agricultural botanists. Among these was R. G. Stapledon of the Royal Agricultural College, Cirencester, who in 1912 was appointed to the University College of Wales, Aberystwyth. One of his first papers dealt with the seeds sold in West Wales (Stapledon, 1914).

His interest in the plant types which developed from the seeds sown by farmers, and the students he gathered around him, set up a new ferment. The effect of this leaven is seen in a paper by Stapledon and Jenkin (1916) on "Pasture Problems: Indigenous Plants in Relation to Habitat and Sown Species." This paper formed another turning point in agricultural thinking. In their conclusions they state "our indigenous herbage plants offer a promising field for study. Nor should modern investigators confine their attention to grasses and clovers only . . . It is most desirable to study the locally successful varieties of *Festuca ovina, F. rubra, Poa trivialis, P. pratensis, Lolium perenne* and *Cynosurus cristatus*, with a view to estimating their relationship to the commercial counterparts, and if necessary with a view to establishing local supplies of the indigenous seed . . . ."

It is an interesting fact that these workers had come to realise the value to agriculture of our indigenous grasses long before they were aware of the writings of Marshall (1789) and Swayne (1790) or the work of the improvers of the early 19th century. The present writer's experience goes back long enough for him to know how little was apparently known about the grass plant and its ways in the early twenties of this century. Even that classic by M'Alpine (1890) on the identification of grasses from their leaves was awaiting re-discovery.

By 1919 the growing of perennial ryegrass for seed had died out, except in a few special areas. This is shown in the survey on herbage seed growing in England, Wales and Scotland made by Mercer (1921). In England the chief centre was in north Cambridgeshire, but a little was still being harvested in

Hampshire under the name of " Hampshire Bents."

It was something of a surprise to find that in Kent the only grass being harvested for seed was crested dogstail (*Cynosurus cristatus*), " which has to be harvested in any case with the wild white clover among which it grows."[21]

Crested dogstail was also harvested in Cambridge. It " is usually mixed with Pacey's perennial ryegrass, and the seed separated by screening after thrashing." No information is given regarding the source of the ryegrass, nor is there any suggestion that it was in any way an exceptional type. This is probably another example of the persistence of a bad habit. That it was probably but an ordinary type, similar to that extensively grown in the same district, may be inferred from the following quotation : " dogstail requires more attention in the cultivation of the crop than do the ryegrasses, but being perennial it may with careful treatment be kept down two, three or more years . . . .Harvest is a trifle later than for ryegrass (so that in a mixture crop a good part of the ryegrass seed will probably be lost in harvesting)."

Ryegrass is not even mentioned in connection with Gloucestershire ; yet Bravendar (1850) reported that Italian and other ryegrasses sown with barley were often seeded and that these crops were probably the most profitable of the course.

Wales apparently grew no grass seeds of any kind in 1921. In Scotland ryegrass seed production was largely restricted to Ayrshire, where it was estimated that 6,000 to 7,000 tons were harvested annually. This was about twice the amount saved in the 1860s (Sturrock 1865). The amounts being grown in Stirlingshire and some other counties in 1921 were very small.

Stapledon (1928) examined the herbage seed position as it then was and he gave the estimated percentage production figures and place of origin of perennial ryegrass seed as 64 per cent from Northern Ireland, 18 per cent from the Irish Free State, and 15 per cent from Ayrshire. Small irregular amounts

[21] Boys (1794) in his report on Kent says nothing about harvesting seed of ryegrass, although he gives the cost of labour for threshing canary, radish and clover seed. But Loudon (1825) states that seed of perennial ryegrass " may be collected by hand in most parts of Britain from old pastures, and a considerable quantity is annually so got in Kent and Sussex ".

Mercer (1921), in discussing the species most noticeable in spring in the old pastures of the Great Chart district, mentions the following grasses : crested dogstail, sweet vernal and meadow foxtail, but not perennial ryegrass. He goes on to say, however, that " some very fine pastures had been established from unusually simple sowings such as : wild white 4 lb., perennial ryegrass 6 lb., and crested dogstail 6 lb. per acre. Such a mixture is a revolution among permanent pasture prescriptions, but the present condition of certain turf examined by the writer, which was originally seeded in this manner 15 years ago, is excellent ". This sward had been closely grazed for the first 13 years. It is unfortunate that the strain of ryegrass seed used is not stated, nor whether the mowing in the two years before his visit was for hay only, or for the purpose of harvesting seed.

It is strange that in his account of the harvesting of wild white clover for seed he should not mention ryegrass as well as crested dogstail as a companion species. May it be that it was the merchants, machining the white clover crops, who realised the value of the fairly considerable aggregate amount of the ryegrass brought in with the clover, and therefore separated it from the other " weed " fractions. Something of this kind must have been happening for an entry for the 6th March 1923 in the grass ledger of the Welsh Plant Breeding Station records that a small sample of seed of " Pedigree perennial, origin old pasture, Kent " had been received from Messrs. McGill and Smith, Ayr.

Mercer did not realise the possibilities of harvesting ryegrass, for when discussing the Wealden soils he says : " Grasses succeed well, especially in the Weald Basin, but it is unlikely that any development will take place in grass seed production in view of the greater profits to be made from clover ".

also came from New Zealand, Denmark and Sweden.

The imports into the United Kingdom and Northern Ireland in 1925 of grasses of all kinds totalled 10,186 tons, of which 5,430 tons came from foreign countries, and 4,756 tons from British countries (Bulletin 1927). According to Stapledon (*loc. cit.*) 4,115 of the 4,756 tons came from the Irish Free State, and consisted of ryegrass.

After referring to the value of Gilchrist's work, Stapledon goes on to say " that the success of a particular species for particular conditions depended not upon the quality of the seed, but to an even greater extent on the actual strain which that seed represented . . . the world is at present (1928) starved for seed supplies of the right sort of herbage plants. In no single case are the supplies anything approaching adequate, while in respect of innumerable species seed of the right sort as a commercial commodity is conspicuous by its absence."[22]

Eaver

It is reasonably certain that the words *eaver*, *ever*, etc., were at first colloquial for perennial ryegrass, and that they did not then signify any special type. There is no evidence that they were used for *L. temulentum.*

The earliest printed form found would seem to be *iver*, used by Fraser (1794) in his agriculture of Cornwall. In this work he gives the seeds sown under barley or oats as " ryegrass or *iver*, trefoil and Dutch clover." The variant *eaver*, now the form universally adopted, was first used by Worgan (1811) in the second report on Cornish agriculture. He gives the seeds used as " red clover 5-8 lb., trefoil 2-4 lb., and from 6-8 gallons of rye-grass or eaver."

Billingsley (1805) in discussing the crop rotation used on a farm[23] at West Camel, Somerset, gives the fourth course as beans (or pease, barley or oats) undersown with " marl grass, broad clover, *Devonshire ray*, milfoil, trefoil, and the best meadow hay seeds."

But the report on Devon by Vancouver (1808, reprinted 1813) contains no reference to eaver, and he only appears to mention ryegrass once : he says " . . . trefoil and ray-grass ; as neither of these grasses are cultivated singly for the purpose of a crop alone."

The first definite reference to some special quality in Devonshire ryegrass comes from Stevenson (1812) in his report on Dorset, but he does not refer to it as eaver. He says the artificial grasses cultivated in Dorset are " red and white clover, trefoil, marl or cow-grass, rye-grass of the common kind, and the true perennial kind which is brought mostly from Devonshire." He reports that a Mr. Bridge allowed 6 lb. white clover, 4 lb. trefoil, 4 lb. cowgrass, and one bushel of Devonshire ryegrass per acre. When the latter was sown by itself for seed two bushels per acre were used. This ryegrass " affords much keep after being mown, but the sheep are believed, in some small degree, to prefer the common kind. One bushel of Devon rye-grass weighs as much as two

[22] An indication of the change that had come about by 1948 is given in " Five hundred varieties of herbage and fodder plants ", Bulletin 39 (edited by Miss M. Hall), Commonwealth Bureau of Pastures and Field Crops, Aberystwyth.

[23] Mr. White Parsons, whose farm was surveyed on the 9th and 10th August 1803 on behalf of the Bath and West Society. It was " adjudged as the most completely improved farm " by a panel of four, headed by Billingsley, the author of the Somerset report to the Board of Agriculture.

bushels of the common sort, which contains much *bob-grass* etc."[24]

A Mr. Goodenough of Frampton sowed 5 lb. milled trefoil, 5 lb. broad clover and 2 bushels of Devonshire rye-grass per acre. " This kind of rye-grass is 8s. or 9s. a bushel, and will last ten or twelve years." While T. Weld, Esq., at Lulworth, in order to get seed in a pure state sowed 3 bushels per acre ; " the seed is often worth 10s. 6d. per bushel, and is larger and heavier than the common sort."

Stevenson, after quoting from Billingsley's (1797) report on Somerset on the selection and cultivation of the true perennial ryegrass by " Mr. Peacey of Northleach, Gloucestershire," goes on to say : " Mr. Spear of Monkton supposes that the kind of rye-grass which is generally called *Devonshire rye* or *Devonshire ever* in that part of Dorset which is contiguous to the county of Devon, is similar to that which was cultivated by Mr. Peacey ; and he entertains a high opinion of its merits ; it becomes green again soon after mowing and produces much feed, while the common kind looks as brown as a stubble, and he never finds it pernicious by growing amongst the wheat if the land be harrowed down properly after ploughing."

The amount of *ever* or rye grass seed sown varied considerably. Thus a Mr. Ottan of Wooton Fitzpaine, who frequently retained his fields in grass for 6 or 7 years, sowed only two pecks with his clovers ; " he believes it is best to sow but little on good ground. Devonshire rye-grass is often grown purposely for seed on new broken grounds such as furze, brake, etc. A peck of this seed, according to Mr. Ottan, weighs 9 lb. and is worth as much as a bushel of the common sort." A Mr. Groves of Bettiscombe said it was " common to sow 3 bushels per acre of the Dorsetshire rye-grass, while some sow only 3 pecks of the Devonshire kind, which was worth 9s. per bushel in 1809." A second year stand of Devonshire rye-grass on Luke Farm, Abbotsbury, gave 28 bushels per acre of seed, worth 6s 6d. a bushel.

It is stated by Stevenson that the Devonshire rye-grass produces seed of a deeper and larger body than that of the common kind. The leaves of this plant are also larger and more numerous, and if, as is very probable, the plant which bears the smallest leaf is preferred in some measure by sheep, yet this objection is over-balanced by a superiority in bulk, and a longer extended period of luxuriant vegetation, which are qualities acknowledged to belong to the Devonshire, or Peacey's rye-grass."

A comparison of a different kind is made by a Mr. Billet of Warmwell, who observed that " it does not get *sticky* like the common sort."[25]

Stevenson (*loc. cit.*) had a very clear idea of the agronomic worth of the two forms of perennial ryegrass. Thus he writes (p. 284) " the common rye-

[24] Stevenson on p. 465 describes bob-grass as " a kind of oat-grass which is often found among ray-grass ". Withering (1818) gives the English names for *Bromus mollis* as soft brome grass, lob-grass, oat-grass ; Curtis (1812) calls *B. secalinus*, Lob ; Pitt (1796) speaks of oat grass (*Bromus mollis*).

[25] Mortimer (1716) referring to ryegrass says " the stalk is apt to grow hard and sticky ".

This sticky condition was almost certainly due to the presence of *honey-dew* the *Sphacelia* stage in the development of ergot (*Claviceps purpurea*) (Sampson and Western, 1941). The sticky exudation begins to appear very soon after anthesis, that is, when normally the caryopses would have begun to form.

If Devon eaver and Pacey's were later flowering than the common sort, as was probable, then the former would be clean when the latter, if infected, would have already become sticky.

grass has been long complained of as an improper plant for seeding fields which are intended for permanent pasture. It obstructs the growth of all the valuable natural grasses, while its own produce is very trivial. This, however, is by no means the case with *Peacey's rye-grass*, which is used in this county for either temporary or permanent pastures. In the latter case it gives way after a number of years to the natural grasses of the soil, many of which are scarcely superior, either in respect to abundance of produce or any other good quality . ."

He returns to this question when considering the use to be made of the natural grasses, and he writes (p. 313) " much has been said on the propriety of laying down land to permanent pasture by sowing seeds of natural grasses, and no trivial objections have been made against the use of ryegrass with this intention, but if the testimony of the farmers in this county is of any weight, the Devonshire rye-grass ought to be preferred even before those which are called natural grasses."

" This kind of grass produces much blade, in comparison with that of the common kind ; it soon becomes green again after the scythe ; and though it will finally give way to the natural produce of the soil, the value of the pasture does not seem to be increased by that circumstance, as is the case when common ryegrass is used. These appear to be important circumstances, and it is scarcely less so that the seeds of the Devonshire rye can be procured at about 8s. or 10s. a bushel when the same quantity of natural grass is not to be obtained under double that price."

It is evident that farmers in Dorset at the end of the 18th and the beginning of the 19th centuries were inclined to regard Devonshire eaver and Pacey's as agronomically similar, or even identical. In the Flora of Devonshire by Jones and Kingston (1829) " Lolium perenne (Darnel or Rye-grass)" is referred to as " the *Heaver* of our western agriculturists." Perhaps the special qualities which had been attached to the eaver, as described by Stevenson, no longer obtained.

It is almost certain that after Pacey gave up farming direct supplies from Northleach discontinued. Did it follow as a consequence of this that the source, direct or indirect, of Devonshire ryegrass also dried up ?

George Sinclair (1826) makes no mention of Devon Eaver in his *Hortus Gramineus Woburnensis*, neither does Karkeek (1845) in his account of farming in Cornwall. The name is, however, to be found among the eleven varieties listed by Lawsons (1836), who described it as " Devonshire Evergreen Ryegrass, commonly termed *Devon Evers*—this variety does not yield such a bulky crop as the last (Pollexfen's Orkney Ryegrass), but it is still more perennial in its nature and withstands the rigour of winter well ; hence it derives its name of Evergreen." In their *Agrostographia* (1853, 4th ed.) the word " last" in the first sentence above is replaced by " Orkney," and a new sentence is added, viz. " It is a very good variety for sowing in orna ental grounds." In the 6th ed. (1877) the only change is the replacing of " Orkney" by "ordinary."

Suttons (1860) list has both names together : " Ever-green Rye Grass, Perennial Devon Eaver, 7s. 0d. bushel," as though synonymous. But neither is mentioned by Punchard (1890) in his review of farming in Cornwall and Devon.

An encyclopaedia edited by Green and Young (1907) contains an article by Principal Percival in which he refers to the selections made by " seedsmen and farmers." The selections are said to have become impure after a time so that the commercial samples to which special names are now attached exhibit very

little difference between each other. Pacey's Rye Grass, Devonshire Eaver, and similar designations refer to good samples of seed, which are heavier and in other respects superior to those sold as "ordinary ryegrass." Almost simultaneously with this we find in Wright's Encyclopaedia (1908-11) an article signed A.N.M'A [M'Alpine]: he says "Perennial Ryegrass is lasting only under certain circumstances. Seed must have been taken from lasting varieties, and this is not the case with ordinary commercial seed; it may be called Pacey's Rye Grass or Evergreen Rye Grass, but the fine-sounding name adds nothing to the duration . . . "

The situation regarding seed growing in the south-west at the end of the second decade of the 20th century was investigated by Mercer (1921). During his survey he was told that the original Devon Eaver came from the Okehampton district, with Sampford Courtenay as the main seed growing centre. The reason given him for the discontinuation of seed saving was the inability of growers to get the seed cleaned,[26] while the amount of seed being produced did not warrant the installation of cleaning machinery.

The local popularity of Devon eaver is shown by the fact that it was being sold for 4s. 6d. per lb. [a bushel ?] when the price for Irish and Scotch perennial was but 2s. 6d. "It is thought that the strain justified its reputation and would pay for rejuvenation." According to Mercer's report "ryegrass (Devonshire Eaver) used to be seeded in North Cornwall (Perranporth), but is no longer saved . . . This is the same ryegrass as previously mentioned at Okehampton, Devon." In a review of seed growing in Cornwall by Jenkins (1927) it is stated that ryegrass seed was being saved, but on quite a small scale. There is no indication, however, of the areas where this was being done.

The work of Horne (1946) has led to a revival of interest in these local strains. He found as a result of a survey he carried out in the two counties that a certain amount of seed was still being grown, especially in Devonshire. In the case of Cornish eaver it "had been grown for seed production on arable land for several generations" by Mr. Berryman of Churchtown Farm, Zennor. This is on the north coast of Cornwall, a few miles to the west of St. Ives. The original source of the Churchtown Farm seed was an old permanent pasture near Gurnard's Head, about 2 miles west of Zennor. The seed of another eaver which was discovered at Sancreed, about 6 miles from Land's End, was also taken from an old permanent pasture.

Considerable development has taken place in recent years. The strain of Devon eaver now being multiplied came from an old pasture in the parish of Sampford Courtenay. Certified Eaver seed is grown by Devon farmers under the supervision of the Devon Seed Growers' Association.

Perennial Ryegrass in Ireland[27]

Ryegrass does not seem to have been commonly used in Ireland until the thirties, or perhaps the forties, of the 19th century. It was however, indigenous along waysides and in pastures (Mackay 1836), and by the end of the century

[26] The Seeds Act regulating the sale of agricultural seeds came into force in 1920.

[27] The history of perennial ryegrass in Scotland is being investigated by Dr. Elizabeth Gray, Aberdeen. She read a paper on "The Early History of Ryegrass Seed Production in Scotland" at the Edinburgh meeting of the British Association, Section K, August 1951 (Gray, 1952).

was ubiquitous (Praeger, 1901). *Lolium perenne* was first recorded in the county of Dublin in 1794 by Wade (Colgan, 1904), who regarded it as native. There is some evidence that ryegrass was occasionally sown in the 18th century, for example, at Rathescar, County Louth, about 1778 (White 1808), and this seed was probably imported. In general, however, the hay was seldom from sown grasses, but was " the spontaneous produce of the soil." Loudon (*loc. cit.*) reporting Newenham (1809) states that clover was almost unknown, and that the calculated area under this crop was less than 5,000 acres for the whole island.

Dubourdieu (1802) reporting on County Down, gives ryegrass as one of those generally used when sowing down land. In the north part of the Barony of Ards, and the adjoining parts of the Barony of Castlereagh " where red clover has not yet succeeded, ryegrass and white grass[28] (*Holcus*) are sown, . . . and the farmers are particularly careful in saving their ryegrass etc." If only the Rev. J. Dubourdieu had told us more about this !

In Armagh, according to Sir Charles Coote (1804), " Rye or ray grass is not at all cultivated here," and he does not list it as a constituent of the natural herbage of the soil ; meadow fescue is also absent apparently, but strangely therefore he gives *Festuca loliacea*. The latter is regarded as a natural hybrid between *Festuca pratensis* and *Lolium perenne* (see Jenkin, 1933, for a discussion of this and other hybrids).

The trade of Lurgan when Coote reported was wholly in muslin and linen. An attempt was, however, being made to establish a wheat market there because great quantities of this cereal were grown in the district which was well supplied with corn mills.

The only mention of ryegrass in the report on Londonderry by Sampson (1802) is that it formed eight per cent of the species in a meadow outside a friend's house. He gives a list of articles entering the port of Londonderry up to 1802. Although mention is made of several lots of garden seeds, and also of clover seeds (one consignment of the latter came from Holland, the others from England), only one bulk of " grass seeds" is listed. The imports from Scotland did not include any grasses.

Irish exports to England in 1831 are given by Barlas (1834) as worth over $4\frac{1}{3}$ millions sterling, but although various cereals are given there is no mention of any trade in grass seeds.

The tradition of taking a cash crop of ryegrass seed as part of the rotation was brought into Northern Ireland by the Ayrshire farmers who settled in County Down about 1830 (Mercer, 1929). He does not say how soon afterwards they began producing seed in their new homes, but Murphy (1844) reports that

[28] Evidence given before the Board of Agriculture (1901) Committee on the sale of agricultural seeds stated that screenings bought at 3s. 6d. per quarter of 8 bushels had been retailed to Irish farmers by hucksters at 1s. 3d. to 1s. 6d. per bushel. In some parts of Ireland only two sorts of hay seeds were known, "brown hay seed", which consists principally of loft sweepings, and "white hay seed", which was chiefly Yorkshire fog. The report continues "it should, however, be added that evidence was given that Yorkshire fog will produce a better crop than ryegrass on some bog and inferior land".

Lafferty (1948) reporting on the blind-seed disease of ryegrass refers to a collection of ryegrasses of various qualities made in 1910 by the late Dr. Pethybridge when Director of the Irish Seed Testing Station. Among them were collections of "loft sweepings" which sold in the more backward parts of the country as 'white hayseed', 'brown hay seed' or 'common hay seed', and perennial and Italian seeds of such low bushel-weights as 10 lb., 12lb., and 14lb.

ryegrass was then being sold in Dublin for from 3 to 6s. a bushel. Although he does not mention the origin of this seed, it would not be unreasonable to assume that it was home-grown. Circumstantial support for such a view is given by Sturrock (1865) who, writing about seed growing in the west and south-west of Scotland, says " and within these few years back it has been extending in other districts, especially in north-east Ireland."

By 1889 according to Sir H. E. Cardwright (Fream, 1889), " in the North of Ireland . . . . ryegrass has become a most valuable aid to the farmers. The great demand for the seed in the prairies of America and New Zealand had given the farmers an additional crop . . . and the price was as high as 4s. 6d. to 6s. 6d. per bushel, according to quality."

Ireland in 1908 had 75,000 acres set aside for the production of grass seed (Anon. 1909). The areas concerned were chiefly distributed among the eight Ulster counties of Down, Armagh, Londonderry, Monaghan, Tyrone, Antrim, Cavan and Donegal. The largest producing area outside Ulster was located in the north of County Louth. Small quantities were also annually harvested from the counties of Waterford, Tipperary and Kilkenny. The chief centres for marketing seed were Belfast, Newry, Lisburn, Portadown, Cookstown, Ballymena, Ballymoney, Cootehill, Coleraine and Magherafelt.

The average yields per statute acre were from 5 to 6½ cwt. each for perennial and Italian ryegrasses, and from 2 to 4 cwt. for crested dogstail. The prices paid to the growers were about 15s. per cwt. for the ryegrasses and 80s. for the dogstail.

In 1929 Mercer (*loc. cit.*) gave the acreage normally harvested for seed in Northern Ireland as about 100,000. The amount of seed produced varied wih economic as well as with meteorological conditions. " It follows in a general way the index of agricultural prosperity as a whole . . . In a normal season, about half of the first and second year crop is seeded."

The type of seeds mixture used to provide this seed is of interest. It was generally sown down under oats, seeded the first year and then grazed for the three following years. The mixture given by Mercer is cocksfoot 8-10 lb., wild white clover 1 lb., (these two keep weeds and each other in check), perennial ryegrass 1¼ -1½ bushels, with perhaps a little timothy, broad red clover and alsike. Apparently great care had to be exercised in the use of the broad red clover, and especially so in the north of County Down, as 2 lb. per acre would there smother everything else.

According to Youatt (Fream's edition, 1893) the seed was collected by seeds merchants, cleaned a second time and assorted into various qualities. As the better qualities were generally heavier the weight of a sample was used in England as the criterion of value.

The situation as reported in Youatt (*loc. cit.*) has changed in several respects. Under the terms of the Ryegrass Seed (Control) Order of 1946 it became illegal for a farmer to sell his ryegrass seed otherwise than to the Ministry of Agriculture, or for any person, other than the Ministry, to purchase seed from a grower (Anon. 1946a). Its purpose is to help to ensure that only high quality seed is used in seeding down the ley, and everything is done to discourage the sowing of home-cleaned seed, irrespective of the use made of the hay.

Great stress, therefore, is being placed upon seed quality, and the crops are now graded into six classes according to purity : *A plus* with a purity of 95 per cent or over, through *A* (90-95), *B* (85-90), *C* (80-85) to *D* (70-80), while

lots falling below 70 per cent purity are classed as *sub-standard* (Anon. 1950).

The price paid to the farmer is related to the purity of his crop. The respective prices for 1950 were 62s. 6d., 60s., 54s., 40s., and 25s. per cwt., with 10s. for sub-standard lots. The highest grade (A plus) was first introduced in 1950. All seeds sold for use in seeds mixtures must attain to the statutory minimum germination.

Nearly 80 per cent of the total seed produced is shipped to Great Britain.

The Ministry of Agriculture in Northern Ireland each year seals high quality seed at the machiner's stores, but a new step was initiated in 1949 to safeguard the availability of seed of the highest possible excellence for seeding down. In that year super-grade perennial of nearly 100 per cent purity was sown on selected farms. The 250 acres put down with this seed were harvested in 1950, and after selection and special machining the seed which resulted was distributed in 1951 to growers in Northern Ireland. This additional technique now becomes an integral part of the scheme for raising the general standard of the seed harvested there.

Late 18th and early 19th century ideas on institutions for instruction and experiment in agriculture

Proposals for the establishment of centres for agricultural instruction and experiment are frequently met with in agricultural literature. A very comprehensive and practical scheme with a modern outlook was put forward by Marshall (1799). In the " advertisement " or introduction to it, he states that the proposal was first made in 1777 in the digest of the Minutes of Agriculture (1778). Dr. E. Tatham, rector of Lincoln College, Oxford, in a conversation with Parkinson (1806), suggested " the establishment of a college for the improvement of young persons of education in the art of farming". Parkinson considered it of sufficient interest and utility to be worthy of public notice.

The suggestion of establishing an agricultural college at Cirencester was first put forward by Mr. R. Jeffreys Brown in 1842 when he addressed a meeting of the Cirencester and Fairford Farmers' Club (Bailey 1950). The time was opportune, for by 1844 public opinion had so crystalised that a special committee was set up to give effect to the proposal. Progress was rapid, and in 1845 a Royal Charter was obtained for the incorporation of " The Agricultural College".

The question of experimental farms was also frequently under discussion. A scheme was put forward by the Board of Agriculture on May 29th, 1798 (Clarke, 1898), and several attempts were made to put the idea into practice.

A letter to the Farmers' Magazine by " M.S." (1806) considers the benefit of an experimental farm for the selection and propagation of seeds. The writer emphasises the need to select healthy, vigorous plants, and the necessity for preventing contamination by the " fecundating dust of weaker plants". The plants " should be so insulated as to have no weak plants of the same species, or even genus, in their vicinity". This is followed by a quotation from Dr. Darwin's *Phytologia* (1800) on the effect of different soils and climates in producing varieties, and the need for comparing one's own crops with those of others ; seeds are to be collected from " a superior vegetation," which is more certain to improve crops than an indiscriminate change of seed.

The function of the experimental farm was to generate the best kinds of seed ; ascertain by experiment the best mode of culture ; the plants most

beneficial and injurious to different animals, " the plants best for pastures on different soils, or what plants the best pastures for different animals are composed of " ; the effect of manures on different soils and plants, rotation of crops, and plant diseases and pests.

It was proposed to provide farmers with small " annual supplies from the seminary to keep up a succession of the purest kinds," and thus enable them to replace inferior, or degenerated, varieties. The seminary might also receive from cultivators any new or better varieties with the object of increasing and distributing them, and it would " serve as a school for agriculture for young men intending to become farmers".

The ideas of M.S. were in many ways similar to those of Marshall, and both thought that farmers would benefit from a study of botany. The former largely with a view to its use in producing new varieties of grasses, in which he included the cereals. With Marshall it had an agronomic bias, the recognition of plants in the field ; " . . . . every *good* farmer *is* a botanist, *as far as he is able* ; and *ought to be,* as far as botany relates to agriculture". Again, " with assistance of a glass not only the ray-grass, but any other grass, may be known with certainty by the blade alone". So, in this too, Marshall was a pioneer, and foreshadowed possibilities which were realised by M'Alpine (1890).

Both " M.S." and Marshall were ahead of their times, but there is no doubt that their ideas helped to prepare the way for the educational and scientific advance in agriculture of the last century.

The Welsh Plant Breeding Station and Grass Breeding

For the translation of ideas into action many things are necessary. When ideas have once been assimilated and become accepted, then the time is ripe for their development. Usually there must be a convergence of men, money and the moment, and when this happens a new era of practical and theoretical progress is initiated.

An example of such an event is provided in the founding of the Welsh Plant Breeding Station in 1919, as a research department of the University College of Wales, Aberystwyth.[29] The time proved propitious, not only because the present Lord Milford of Llanstephan made available moneys to provide for the establishment of an institution for plant improvement in Wales, but also because men of the requisite disposition, and with the appropriate agronomic

[29] The Scottish Society for Research in Plant Breeding was founded in 1921. Its genesis was different from that of the Welsh Plant Breeding Station. A conference was held on 26th July, 1918, between representatives of the Highland and Agricultural Society (convener), Scottish Chamber of Agriculture, National Farmers' Union of Scotland, and the Scottish Seed Trade Association. This meeting unanimously approved a proposal to create in Scotland a Station for Research in Plant Breeding. The Directors of the new Society met for the first time on 6th September, 1920, and the Society was registered under the Friendly Societies Act, on 16th February 1921 with headquarters at Craigs House, Corstorphine, Edinburgh.

The Society was financed from a fund raised by subscription, to which the Board of Agriculture for Scotland in June 1921 added an equivalent sum (£22,363).

Donors of £20 or over were entitled to become life members ; if of £10 or over, then membership entailed an additional annual subscription of 10s., for all others there was an annual subscription of £1.

The first Director was Mr. Montagu Drummond, with Mr. William Robb as Assistant Director (Corstorphine, 1922). Mr. Robb later became Director, and he was succeeded by Dr. J. W. Gregor, the present Director. The crops being investigated in 1921 were oats, potatoes, herbage plants and roots.

and botanical experience, were at hand in the persons of R. G. Stapledon and T. J. Jenkin.

Stapledon became Director and Professor of Agricultural Botany, and he appointed Jenkin as senior research officer. The former initiated breeding work with cocksfoot, and the latter with ryegrass, timothy, etc. The forage legumes became the responsibility of the late Captain R. D. Williams, and oats that of E. T. Jones, now Professor and Director of the Station. Grassland agronomy was taken over by William Davies, now Director of the Grassland Research Station, Drayton, Stratford-on-Avon.

In the early years of the Station large world-wide collections of the grasses were made, but especial attention was paid to indigenous material. It was on these latter that selections were mainly based (Stapledon, 1933 ; Jenkin, 1946). In this their approach to the problem of strain-building differed from that of the Continental breeders, who made their selections from within commercially available stocks.

Thus, in the case of S.23, the late-flowering pasture strain of perennial ryegrass, the material from which this strain was built came chiefly from the very old grazed pastures of the Midlands, Lincolnshire, Kent, and to a slight extent from Welsh and Dutch old pastures. In S.101, the late-flowering pasture-hay strain, the material was derived from the Midland and Kent old pastures only. But with S.24, the early-flowering hay-pasture strain, the plants used, although indigenous, did not come from old pastures, and to these " wild " plants a few selected plants from Hawke's Bay, New Zealand, material were added (Jenkin, 1943).

The application of the technique of emasculation to the hermaphrodite grasses (Jenkin 1924) made controlled crossing practicable. This was a great advance since it made possible for the first time a study of breeding relationships between individuals.

By 1939 a series of strains had been developed (Jenkin, 1943) which played no inconsiderable part in increasing productivity and maintaining soil fertility during the war period and after.

The acreages of the three Aberystwyth-bred strains of leafy perennial ryegrass S.24, S.101 and S.23 grown for seed under certification are given below :—

	*S.*24	*S.*101	*S.*23	*Total Acres*[30]
1939	10	100	400	510
1942	10	159	1,202	1,361
1945	37	1,556	4,262	5,855
1950	697	1,227	5,250	7,174

Retrospect and Prospect

The localities where the early growers of improved ryegrasses raised their seed are known only in a few instances. But it is interesting to note that all these were in areas of alternate husbandry and on alkaline soils. Thus Pacey at Northleach, and Whitworth near Caistor, were both on oolite ; Stickney at Ridgmont on chalk, and Neill at Mansfield on magnesium-limestone. Incidentally the first ryegrass seed crop of which we have a record (Plot 1677) was grown at Islip, which is on oolite.

[30] I am indebted for these data to my colleague Mr. Gwilym Evans, who is in charge of Seed Multiplication.

There may be no significance in this other than that such areas were arable, and therefore needed a soil conditioning seeds-break in the rotation, especially if down for two years or longer. This may have been most satisfactorily achieved when the legume was combined with the more leafy, more persistent grazing types of ryegrass, than when used with the common ryegrass and/or hay-loft seeds.

Mention has already been made of the parallel between the development of ideas about ryegrass at the close of the 18th century, and in the early part of the 20th century.

It is now generally appreciated that pedigree strains of crop plants, like pedigree breeds of cattle, will play an increasingly important part in raising agricultural production. For this reason, plant breeding is no longer left to the chance interest of private individuals, but has become the concern of special institutions supported by public funds. These ensure continuity of material, techniques and knowledge. Because of this support and continuity the breeders at the Welsh Plant Breeding Station, and at the Scottish Society for Plant Breeding at Corstorphine, Edinburgh, have been able not only to develop and maintain new strains, but also to initiate long-term researches of a fundamental nature.

The understanding of the grass plant which has followed from all this, and the new techniques evolved, have made possible the " proving " of plants selected as parents and the maintenance of these proven plants by means of vegetative propagation. Some of these " basic " plants in use at Aberystwyth have been so maintained for a quarter of a century. The preservation of key material in this way has important practical implications. It means that each strain can be reconstituted at will, and purity of type is maintained. It thus enables fresh foundation seed of every strain to be systematically and continuously made available for multiplication.

Grass seed multiplication has problems peculiar to itself. Researches relating to fertilisers, seed rates, drill widths, methods of sowing and harvesting, time and kind of cultivation, are providing information and experience regarding the basic requirements of the different species and strains (Evans, 1937). The question of isolation, that is the prevention of contamination of one stock by pollen from another of a different constitution, is a matter of concern at all stages of multiplication in wind-pollinated grasses. The work of Griffiths (1950) indicates the risks involved and the precautions necessary.

The result is that today authenticated strains are assured to any farmer who obtains certified seed (Evans, 1942).

Ideas regarding the use of species and strains of species in the formation of leys are more commonly debated and subjected to closer scrutiny today than ever before, and by a better informed community. The same applies to the management of the leys, whether for grazing by, or conservation for, the farmer's own stock, or for conservation by large scale crop-drying concerns.

The breeder tries to meet, and if possible anticipate, the new needs of the agriculturist. He must, therefore, not only explore the potentialities of new species, but also continue his search for new breeding material of species already in everyday use. This he does by collecting and studying plants from populations of areas not previously examined. The collection of such material is carried out in several ways. It entails the co-operation of other institutions,

such as the Commonwealth Bureau of Pastures and Field Crops, or the National Agricultural Advisory Service, through its Grassland Officers, by exchange with other plant breeding institutes, by collections made by expeditions, or by collections made by the breeder himself from special areas at home or abroad (Beddows, 1949).

Lolium perenne has been more thoroughly studied and utilized to a greater extent than any of our grasses. The richness of the species in plant types should enable it to meet the changing needs of ley farming, in so far as they relate to perennial ryegrass, and it will continue to retain an important place in British agriculture.

II. Italian ryegrass—*Lolium italicum*

II. ITALIAN RYEGRASS—LOLIUM ITALICUM

Origin

Introduction into Northern Europe

Introduction into Scotland and spread in the British Isles

Variation and varieties

Seed production and utilization :

- (*a*) General—1833-1837
- (*b*) J. Rodwell, Alderton, East Suffolk—1839
- (*c*) W. Dickinson, New Park, Hampshire—1843
- (*d*) T. W. Buller, Whimple, Devon, and others—1845-
- (*e*) North-east Cambridgeshire—late 19th and early 20th centuries
- (*f*) County Down, Northern Ireland—present day

Contamination of seed crops by " foreign " pollen

ITALIAN RYEGRASS—LOLIUM ITALICUM

Origin

Italian ryegrass is said to have come from the irrigated farm lands of Lombardy in North Italy. Professor Haussmann of Lodi, near Milan, in a personal communication (1950) writes that reliable information as to its origin is now difficult to obtain, but states: "It is certain, however, that this grass was already being grown in the 13th-14th century, as it was included in the first *marcite* (winter irrigated meadows) of Lombardy, which started in that period."

Lullin de Chateauvieux, in letters written in 1812 and 1813 (Rigby, 1819), described an irrigated meadow on a farm at Santenas, ten miles from Turin, in Piedmont. This meadow was mowed three times in a season, and the plants in it were "*Avena elatior*, oat grass, meadow foxtail, ray-grass, plantain and different trefoils". It is impossible from the word translated "ray-grass" to say which *Lolium* was really present. The species mentioned closely resemble those found in the summer-irrigated hay meadows of the Pyrenees (Beddows, 1949), in which the ryegrass was *L. perenne*.

Smith (1852), reporting on the agricultural canals of Piedmont and Lombardy, credits the monks of Chiaravalle, near Milan, with the introduction of irrigation sometime during the latter half of the 12th century. In the course of time two systems of watering came into use which, because of the difference in season of application, gave rise to summer and to winter meadows. The latter, according to Dominico Berra (1822) in his "Dei Prati del Basso Milonese delti a Marcita," were watered during the period from 8th September to 25th March. The best sources of water were the underground drains of Milan, the *Naviglio Interno*, and the *Vecchabbia*. The temperature of this water could be up to 27°F. above air temperature, and the greater this difference the greater the stimulating effect on the growth of herbage.

Smith (*loc. cit.*) gives the mixture used in sowing down land to form a *marcite*: oats sown in April at 4½ bushels per acre were, after harrowing, oversown with "clover (¼ bushel) and the *Lolium perenne* (1 bushel) per acre". (A footnote states: Italian ryegrass.) The field was then rolled with a heavy stone or wooden roller, and this was followed by the opening of channels 9 inches wide and 6 inches deep.

The first Italian-like ryegrass to be given a binomial was the *L. multiflorum* of Lamarck (1778). This, according to Lamarck and Candolle (1815), had awns towards the top of the spikelet, in contrast to Vaillant's form, which they described as having awns which were too numerous and too long. Vaillant (1727) found the latter type near Paris, and he called it *Gramen loliaceum angustiore folio et spica aristis donatum* (Rouville, 1853), i.e. the *Lolium* grass with narrow leaves, and ears with awns. That he thought it a variety of *L. perenne* is clear, as this species was described by Bauhin (1671) as *Gramen loliaceum angustiore folio et spica* (Hudson, 1778). Martyn (1792) writes of *L. perenne*: "the flowers are now and then found with awns or beards," while Smith (1828) writes: "outer valve . . . generally with a short *awn*, just below the cloven tip, scarcely discernible, and frequently wanting". Again, Lindley (1841) gives *L. perenne* as having "Paleae very slightly awned. Spikelets longer than the glumes."[31]

[31] According to Jenkin (1935) the following authors also refer to awned forms of *L. perenne*: Ray (1724), Thuillier (1794) and Retzius (1795). In the case of Kunth (1833) and Koch (1857) the florets (or spikelets) are described as either awnless or awned.

Although Hudson (*loc. cit.*), Withering (1818) and Smith (*loc. cit.*) all list Vaillant in their bibliography, not one of them refers to the long-awned form, nor to the beautifully drawn inflorescence which is reproduced by Rouville.

Sinclair (1826), enumerating the forms of *Lolium*, gives Roemer and Schultes (1817) as the authority for the following: "*multiflorum per.* many (20-25) flowered ryegrass, nat. France; in pastures, and on the margins of corn fields."

Forms of Italian ryegrass were therefore to be found in northern Europe long before it was named *L. italicum* by Braun (1834). Morton (1856) regarded Italian ryegrass as a native of southern Europe, "where, however, it is by no means common in a state of nature".

Introduction into Northern Europe

It was apparently first grown outside Italy by Fellenburg at Hofwyl in Switzerland at the beginning of the 19th century (McAlpine, 1889). It was also grown in 1818 by André Thouin in France, where Matthieu de Dombasle, who obtained seed from Fellenburg, greatly increased its cultivation. Lawson (1836) gives an extract of Boutteville's letter to Vilmorin, translated from *Le Cultivateur, Journal des Progrès Agricoles*, Paris, 1835. He compares his experience with that of Vilmorin and Dombasle. He proposed to reap 12 acres of pure Italian in 1835, and had sown down another 12 acres, and with his Italian plus clover mixture he had sown 32 acres, and intended sowing an additional 8 to 10 acres more in the autumn, a total of over 60 acres.

Lawson (*loc. cit.*) also reprinted an extract from an article on Italian ryegrass which appeared in *Bulletin des Sciences Agricoles*, and which they state was published in the Quarterly Journal of Agriculture for January, 1832.[32] It was probably this article which caused them to set about obtaining seed, for they say "as there is no account of any trials having been made of this grass in Britain, it was an object of some importance to obtain a few seeds or plants of it for the purpose of observing its characters and mode of growth in this country".

Introduction into Scotland and Spread in the British Isles

Italian ryegrass was first introduced into Great Britain by Lawson of Edinburgh, who, in 1831, imported seed from Hamburg. This firm was also presented with a small parcel of seed from northern Italy obtained by Mr. Thomson of Banchory at the Munich Agricultural Exhibition. Samples of both lots, and of Stickney's perennial, were sown for comparison at Edinburgh. All three samples brairded simultaneously, but the seeds from Hamburg and from Italy gave rise to plants showing a marked superiority in growth to those derived from Stickney's perennial ryegrass. This advantage was maintained throughout the season.

The two imported ryegrasses proved to be similar in appearance, having a broader leaf and more luxuriant growth than Stickney's. When the two new lots came into inflorescence they were found to be similar and to agree with the description given in the *Bulletin des Sciences Agricoles*. They confirmed the report obtained from Hamburg that this kind of ryegrass was more juicy and

[32] This reference is incorrect, for there is no such article in any volume of the Quarterly Journal. I am greatly indebted to Mr. F. C. Hirst, the Librarian of the Ministry of Agriculture Library, for this information.

possessed a richer foliage than the common ryegrass, but Lawsons had not at that time been able to test the report that it was more relished by cattle. Burke (1834) refers to the species " lately introduced from the continent under the name of Italian rye-grass, and is distinguished from the common species by its larger leaves, by being of a darker green, and by growing to a greater height. On comparative trials with some of the most favourite kinds of the common ryegrass, it has been found to exhibit a great superiority of growth, and it has been represented as being softer, more juicy, and more greedily eaten by cattle, whether in a green or dry state. It is also said to be of such a hardy nature that when cut in November it has put forth fresh shoots of a foot in length in the close of December, and has been found to stand the winter in the north of Europe. Its durability in the soil, as a perennial grass, remains yet, however, to be proved ; and although the experiments which have been already made seem to confirm the high character which has been given of it in other respects, yet further experience seems necessary to determine its real value."

It was not known by Lawsons at the time of the first importation whether this new fodder plant was a native of Italy or Germany, nor where it was first cultivated. It is easy to imagine the keen interest with which they watched the development of this ryegrass, and to appreciate the thrill which its performance and promise must have provided.

The cultivation of the new ryegrass rapidly spread from Scotland to Ireland and to England. The astounding progress made in the use of Italian ryegrass has already been indicated The following figures taken from Morton (1855), and from Wilson (1860) for 1855, refer only to imports by Lawsons of Edinburgh.[33] The fall in price level with increasing supplies is also shown

		bushels	*price per bushel*
From Hamburg, Germany			
	1831	160	42s. 0d.
	1832	320	35s. 0d.
	1836	1,000	15s. 0d.
	1840	5,000	10s. 6d.
From Leghorn, Italy			
	1841	6,000	10s. 0d.
	1850	25,000	7s. 6d.
	1851	28,500	7s. 6d.
	1852	30,000	6s. 0d.
	1853	40,000	5s. 6d.
	1854	32,900	5s. 6d.
	1855	35,000	5s. 0d.

The 6,000 bushels imported in 1841 came from Lodi, near Milan, in the Plain of Lombardy.

Other seed firms also began to import seed. Messrs. Thomas Gibbs and Co., Corner of Half Moon Street, Piccadilly, in their advertisement in the catalogue for the 1843 Derby Show of the Royal Agricultural Society of England,

[33] That the increasing use of Italian ryegrass was general is shown by the following figures supplied to Morton (1855) by a Mr. Rendle, a seedsman of Plymouth. His retail sales for the 15 years from 1840 to 1854 were : 25, 30, 30, 50, 50, 60, 70, 90, 100, 180, 240, 400, 500, 600 and 700 bushels.

listed for the first time *Lolium multiflorum*, *L. submuticum*, *L. bretagne* and *L. italicum*. Also advertising *L. italicum* in this catalogue were Messrs. George Gibbs and Co., of Down Street, Piccadilly. No prices were given in either case, but by 1846, at the Newcastle-on-Tyne Show, the price was 8s. 6d. per bushel for the " tall variety, true".

Morton (1856) reports that immense quantities of Italian ryegrass seed were being harvested yearly. In this connection it is of interest to compare the fourth (1853) edition of Lawson's *Agrostographia* with the sixth (1877) edition. The former states: " Different opinions are still entertained as to the real merits of the Italian Rye Grass, but perhaps the best proof of its excellence is the great and yearly increasing demand for its seeds." In the 1877 edition there is a change of emphasis, for the words used became: " only one opinion is now entertained as to the real merits . . .," and then as before. It has not been possible to examine the fifth edition of 1855, and therefore we are unable to say when this unqualified approval of Italian ryegrass was first accorded.

Variation and Varieties

Before many years had elapsed different forms began to find their way on to the market. In the catalogue for the Newcastle-on-Tyne Show in 1846, George Gibbs and Co. were offering two types of Italian ryegrass, the " tall variety, true " at 8s. 6d. per bushel, and the " Dwarf Brown, Mr. Rodwell's".

At the York Show of 1848 the catalogue carried advertisements offering " the variety grown by Mr. Dickinson with so much success " and the " Dark Italian grown by Mr. Rodwell". The former was priced at 8s. 6d. a bushel, but the latter type seemed not to have had its price made public. By 1849 both Dickinson's and imported seed were being sold at 8s. 0d. a bushel.

The " Advertiser," a trade supplement at the end of the Journal of the Royal Agricultural Society of England for 1858, carried an advertisement by Sutton and Sons, Reading. This offered " the undermentioned kinds true and clean: Italian ryegrass, fresh imported; Italian ryegrass, English saved; Suttons improved Italian ryegrass".

Morton (1856) described the situation as follows: " The Italian ryegrass presents fully a greater diversity of form than even *L. perenne*; hence in almost any field of the former, counterparts can be picked up of most of the botanical varieties of the latter. And hence, as might have been expected, numerous cultivators have from time to time brought forward supposed improved varieties, to which has generally been appended their own name or that of their residence; but even the best of these, with, perhaps, the exception of " Dickinson's improved," have obtained only a local and ephemeral character for excellence, consequent, no doubt, in a great measure, on the almost unsurmountable difficulty of growing the seeds free from mixture with those of *L. perenne* in a country in every field of which that species is naturally and abundantly indigenous". According to Messrs. Drummond of Stirling (Morton, 1855), " much of the British-saved seed is in its character and habit so like common rye-grass that it is not one whit earlier".

Morton (1856) describes *L. multiflorum* (many-flowered annual ryegrass), Bailly's short-awned annual ryegrass, and Brittany many-flowered annual ryegrass. When the above-named forms went out of cultivation is not known, but Dickinson's was still listed in " Sutton's Catalogue and Amateur's Guide " for 1860. The advertisement of George Gibbs in the 1869 issue of the Journal

of the Royal Agricultural Society referred only to "*Lolium italicum*, Italian ryegrass, 5d. lb."

The examination of some recently issued seeds catalogues shows that interest in Italian ryegrass remains very active. What is rather surprising is the number of sources from which Great Britain draws her supplies: they include Ireland, Scotland (Ayrshire), England, New Zealand, Denmark, Holland, France and Germany. In some cases several grades of seed are available, and the prices in 1951 ranged from 1s. 4d. to 1s. 9d. per lb., or from 140s. 0d. to 175s. 0d. per cwt.

In 1951 an Italian ryegrass strain, S.22, bred at the Welsh Plant Breeding Station, was first grown in bulk for the provision of Foundation Seed.

Seed Production and Utilization

(*a*) General, 1833-1837

Seed production was rarely a single aim with the earlier growers of Italian ryegrass. The seed crop was the cash producer, usually one of a series of soiling cuts and/or grazing sequences. Sometimes two crops of seed were taken, and one of the earliest examples of this is probably that of Mr. Gorrie, Annat Garden, Scotland. He sowed down a field on 9th April, 1833, and from it, in the same year, harvested two crops: this field was similarly treated the following year (Lawson, 1836).

The Highland and Agricultural Society of Scotland as early as 1835 offered premiums to encourage the growing of Italian ryegrass for seed because of a shortage due to the increasing popularity of the new fodder plant (Ramsay, 1879). The premiums of £10 and £5 were to go to the person who grew the largest amount of good quality seed, "it being found that it may be equally perfected in Scotland, as in those parts of the Continent from which the chief supply had hitherto been obtained".

In Ireland the first seed crop seems to have been taken in 1834 near Lisburn, about 10 miles south-west of Belfast. The seed, supplied by Lawson of Edinburgh, was sown on the 4th May and by 31st July, the crop was 4 ft. 8 in. tall and ripening its seed. The aftermath growth reached a height of 4 ft. 6 in. by the end of September, when it was again ripening seed (Gorrie, 1834).

The Farmers' Magazine (Anon. 1840) contains a letter from "An Irish Farmer" of Kilkenny, who says, among other things, that a field sown in 1835 with seed imported direct from Leghorn had been harvested for seed each year up to 1840. The aftermath was always grazed by sheep and the field was dressed with soot each winter, so that the crop was "now as thick and healthy as in the first year". He refers to another field mown for hay the first year, and grazed the next, which had lost all trace of Italian after July, yet both fields had been sown down with the same seed. He puts the question: "Are we then to conclude that it is an annual, but that from the shedding of the seed a new growth is obtained which keeps up the succession though the old plants die?"

Hillyard (1837), President of the Northamptonshire Farming and Grazing Society, wrote "Ryegrass (*L. perenne*) should not be sown for a one year's clover ley. The Italian ryegrass is said to be the most productive and best. My first crop is now growing for seed and it promises to answer my best expectations. I have little doubt but that after the crop is carted off, and the land manured, I shall with one ploughing get a fair crop of white turnips".

(*b*) J. Rodwell, Alderton, East Suffolk, 1839

Rodwell (1841) was a well-known grower of seed whose " Dark " or "Dwarf brown " Italian has already been referred to. He farmed at Alderton, near Woodbridge. He sowed 6 acres of Italian on 4th May, 1839, at 4 pecks (1 bushel) per acre, on wheat drilled the previous November. A heavy wheat crop was harvested at the end of September, and although the grass was then rather weak, it soon became so vigorous and strong that it carried 8 sheep per acre for the four weeks 20th October to 18th November. By 26th March, 1840, the growth was again very strong, with leaves 14 to 16 inches long, and " heading for seed". This was grazed by 20 sheep and their lambs until 1st May, when the field was closed for seed which was harvested on 5th July, *i.e.* in 65 days. The crop stood 4½ ft. high and produced 32 bushels of seed per acre. The aftermath carried 10 sheep to the acre for 14 weeks—until November, when it was ploughed in preparation for oats.

Rodwell (1845) expressed doubt as to whether the pale coloured, erect-growing type derived from long-awned seeds was genuine Italian. He wrote : " But I am furnished with proofs indisputable that these characteristics are not descriptive of the best kind of *Italian rye-grass*, but that the most productive and most nutritive plant is that which has a more fibrous root producing a dark coloured spreading stem, the produce of seed which has a short awn".

Three years of observation followed the first realization that there appeared to be two types. He imported fresh seed direct from Italy and used it to compare with the two other forms " with great care and attention, and I am now fully convinced . . . the most productive and the most nutritive for all cattle is the plant which spreads upon the ground, is dark coloured, and being the produce of seed with a short awn . . ."

He goes on to say that where a biennial or perennial grass is required, " the dark coloured is much preferable to the pale coloured grass, the former branching and becoming thicker, the latter spindling up and then becoming thinner in plant every succeeding year". He regarded the former as more than 30 per cent superior to the latter. Rodwell reproduces a letter from a farm bailiff in support of the above contention. " I quite believe, in fact I am quite sure, that sow what quantity you will of the pale grass, you cannot get a good bottom without some of the brown with it". The evidence was apparently clear to anyone who looked at " our layers [leys] this spring".

This spreading type with the short awn and dark coloured stems was regarded by Sturrock (1865) as being *L. perenne* var. *submuticum*, "long thought more or less spurious, is now considered the best". Yet he goes on to say that the awn is the best criterion of genuineness in purchasing seeds of Italian ryegrass.

(*c*) W. Dickinson, New Park, Hampshire, 1843

Another well-known grower of Italian ryegrass seed, and an enthusiastic and successful advocate of liquid manuring, was William Dickinson of New Park and Burley Rails, in the New Forest. He must have been mechanically minded, for according to Wilkinson (1861) he was " rich in implements".

In a very long letter to the Duke of Richmond, President of the Royal Agricultural Society, Dickinson (1845) described his method of cultivating Italian ryegrass for horse feed, " the success of which has astonished me very

much and which I am anxious to make known for the general welfare of agriculture at large." He broadcast 4 bushels per acre of seed "grown by myself *without weed*," and bush-harrowed it in, since iron harrows buried the seeds too deeply. His land, strong clay, under-drained and in good heart, was finely pulverised during the summer months after tares or early corn. Any weeds coming up in the crop during the autumn (1843) were hand pulled. The first herbage cut was taken during the first week of March, 1844, when the growth was about 10 inches high. The subsequent cuts were taken on 13th April, 4th May, 24th May and 14th June. The sixth crop was allowed to run into head and was harvested for seed on 22nd July.

Each of the above cuts was followed by a single application of liquid manure applied by means of a London water-cart. The strength used was two parts pure urine from the stables to one part water. Although this provided a more or less uniform application after each mowing, he observed that the yield of fodder increased as the temperature of the atmosphere improved with the season. Dickinson did not, however, apply any liquid to the stubble of the seed crop because he was afraid it might injure the fallen seed. This was harrowed well, now using the iron harrows, but, as he said, "expecting nothing more from it". In this he was mistaken, for the resulting stand gave several light crops in 1845, the third being a seed crop.

In later sowings he reduced the seed rate from four to two bushels per acre by the use of "Mr. Smart's broadcast drill". The cost of the latter £3 10s. 0d. was immediately recouped in the seed saved, the resulting stand was more even than after hand sowing, and by its use seed could be sown in windy weather.

Dickinson too found Italian ryegrass to vary, and it did so as much as "English ryegrasses or English fruits". In support of this he refers to differences in plant height at the time of flowering, some stands reaching only 1½ ft., while his own crops were 4 to 5 ft. high. This contrast may, however, have been nothing more than response to different levels of fertility.

At the request of the President of the Royal Agricultural Society, Dickinson (1848) gave the public the benefit of his experience with this crop since 1845. This long report is based on a questionnaire returned by 32 persons out of nearly 90 to whom he had supplied seed. The results, as might be expected, were variable: heavy undrained land gave very little return even when fertilised; light land required to be very well treated to get a reasonable return, but Italian did well on any soil, light or heavy, so long as it was in good heart.

(*d*) T. W. Buller, Whimple, Devon, and Others, 1845-

One of the growers who replied to the questionnaire was Captain T. W. Buller, farming at Whimple, about 8 miles north-east of Exeter, on red sandstone of moderate quality. He submitted a detailed analysis of his cropping and costs, and it was estimated that 6 acres of Italian gave a profit of £7 9s. 8d. per acre. Buller concludes: "Much as my expectations were raised by what I saw on your [Dickinson's] farm last year (1845), I have no reason to be disappointed with the present experiment, and I am now (2nd September, 1846) about to sow 9 acres more for another season. At the same time I think there is one thing which, not being attended to, is likely to occasion frequent disappointment in the growth of Italian rye-grass. I think it is not generally sufficiently considered that no plant which yields an unusually large and valuable produce can be grown without an unusual supply of manure. I believe

this rule to be without exception, and not applicable to Italian rye-grass alone, but to all heavy and at the same time valuable crops. I am led to this remark by what has already occurred, for when I have been asked what dressing I have used, and mention 9 cwt. of guano per acre, the reply has always been, ' Is not this enormous ?', to which I can only answer ' Look at the produce ' ".

Capt. Buller goes on to say : " From what I saw at your farm last year, as well as from my own experience in this, I have a full conviction that upon good, deep, heavy soils with abundance of manure, and especially liquid manure, it is possible to grow 40 or even 50 tons of rye-grass per acre in a single season ; and, if so, the question for a practical agriculturist is, ' what is the value of a ton of rye-grass, and what is the value of a ton of manure ' : and he will then be able to say how many tons of manure he can apply with a prospect of profit".

According to Raynbird (1847), it had recently become the practice of Suffolk farmers to sow Italian ryegrass and trefoil on the wheat stubble in order to provide spring feed. When the herbage had been grazed down, the land was broken up and summer fallowed or sown with turnips.

Raynbird gives an account of how they harvested the seed, for it " may be interesting, from its novelty". The crop was cut before it was perfectly ripe, preferably in the early morning, since the seeds did not shed so readily when damp. All large weeds such as docks, thistles, etc., were picked out by children from the grass while it lay in the swath. The next morning as early as possible the crop was tied into sheaves which were arranged in shocks of four. This also helped to reduce shattering. Threshings began about 10 days later, and given a hot, dry, calm day it could be done on a flat piece of ground in the field. A man and boy with a light cart, across which a cloth was laid to catch the loose seed, kept four or five threshers going. The threshed seed was dried by spreading thinly over a floor and turning frequently. On hot days the seed was placed on rick cloths and exposed to the sun.

Raynbird reports a Mr. Parkinson of Nottingham as saying that the introduction of Italian ryegrass had doubled the quantity of cattle " on the same occupation both in rearing and summer fattening". It is somewhat strange that he made no reference to Rodwell who, as already indicated, was a well-known grower in East Suffolk.

The growing of seed of both Italian and perennial ryegrass gradually became localised.

Everitt (1897), who claimed to be one of the largest seed merchants in the Eastern Counties, states that the country was at one time dependent to a large extent on France for its Italian ryegrass. This seed always contained numerous weed seeds, and this " foulness " was a matter of universal complaint.[34] This

[34] That this stricture could be applied generally to imported Italian ryegrass seed is borne out by the following quotations. An advertisement in 1860 for *L. italicum* stated: "The foreign seed is generally exceedingly foul when it comes to hand and we clean it thoroughly before selling, which reduces its bulk and necessarily increases the price ; but we can supply it cheaper if sent out just as we receive it in the bales unopened". Sturrock (1865) writes : "Foreign Italian as imported is in most cases very foul with weed seeds of all kinds, and should never be sown till thoroughly cleaned". While Sutton (1886) says : "The seed which is imported from the continent yields a very heavy crop, but it is so infested with pernicious weeds as to need most careful cleaning before it is fit to sow". Then McAlpine (1889) reports that "seed from Italy is very impure, and inferior in quality to Scotch."

A sample of " Mayenne " Italian ryegrass received in 1948 contained the following inpurities, arranged in order of frequency : *Bromus mollis, B. secalinus, Plantago lanceolata, Sherardia arvensis, Ranunculus repens, Chrysanthemum Leucanthemum, Leontodon* spp., together with several legumes and *Poa* spp. (Beddows *loc.cit.*)

firm was therefore getting most of its best supplies from Northern Ireland, Scotland and parts of East Anglia, notably the fen districts.

(*e*) North-east Cambridgeshire—end of 19th and Early 20th Centuries

By 1921 Italian ryegrass seed production in England had become mainly centred in the fen country in the north-east of Cambridgeshire: Padnal Fen. Middle Fen, Burnt Fen and Swaffham Fen (Mercer, 1921). The district around Prickwillow produced most, and here seed growing formed part of the rotation, nearly every farmer being a producer. They drilled the Italian at 2 bushels per acre in mid-May on the winter wheat. Although the seed was " home-grown " there was nevertheless a considerable local exchange, because the farmers liked a change of seed every few years.

After the wheat harvest the Italian was left until the end of September (Michaelmas) when cattle were put into the field and kept there until they had grazed it down bare. The Italian was then left until the spring when it was rolled and again grazed by cattle until about the 1st May when the field was " put in " for seed. The crop was ready to harvest about 10 weeks later, that is, in the second week of July, if *when the heads were lightly grasped in the hand*, a few seeds remained in the fingers. At this stage the flowering glumes would be whitening towards the tip and edges, with the furrows white, but the ridges green. The straw seen in the mass would present a silvery appearance, but the ridges would be green here also.

The aftermath was sometimes fed, but frequently a second seed crop was taken in September. The land would if possible then be " cut over " to get rid of weeds before ploughing for autumn wheat. A fairly typical rotation was wheat, mangolds (or other root crop), wheat, Italian ryegrass: *i.e* wheat came in alternate years. In some areas barley replaced wheat before roots.

The manuring system is interesting. The first wheat crop received the farmyard manure and the roots a dressing of artificials, but the subsequent seed crop got nothing except *stock nitrogen* during the grazing periods. Sometimes a field was kept on for a second year, but the stand was usually thin and very weedy. There was also, as a rule, a great increase in the wireworm population, which caused considerable damage to the following wheat plant.

Farmers in other parts of Cambridgeshire apparently experienced difficulty in getting rid of the Italian from fields where it had been previously sown, but Mercer did not find the fen farmers embarrassed in this way.

The yields they obtained were: in the first year, July crop, 10-12 cwt., September crop, up to 3 cwt.; in the second year, July crop, 6-7 cwt., September crop 2-3 cwt. per acre. Seed from the second year stand " is conspicuous for its smaller size and lesser development of awn".

For some years now there has not been any large-scale growing of Italian for seed in Cambridgeshire, and at the present time the two main centres for its production are Ayrshire and Northern Ireland, especially the latter.

(*f*) County Down, Northern Ireland—Present Day

The Ministry of Agriculture for Northern Ireland, through its journal, *Monthly Report*, frequently deals with the technical and other problems of seed production, *e.g.* Anon. 1941, 1945. A fairly detailed account of the practice of

one of the ablest and longest established growers[35] of Italian ryegrass seed was given in a recent volume (Anon. 1946b).

The rotation he uses on the arable part of the farm is as follows: seed potatoes, oats, Italian ryegrass and back to potatoes. Thus the Italian is treated purely as a tillage crop. The grazing and hay required for the cows and bullocks is provided by permanent grass.

The Italian is sown at the rate of 28 lb. per acre immediately before the final harrowing of the oats, after which the land is well rolled. The oats used are Victory and Yielder as these best resist lodging. After the removal of the oats the grass is allowed to grow unchecked until seed time. The thinner, coarser stand obtained in this way has been found to give better seed heads and higher yields than did the thicker stand which followed grazing lightly with sheep in the autumn and spring.

Manurial treatment begins with the seed bed, which receives a mixture of 2 cwt. superphosphate and 1 cwt. sulphate of ammonia per acre. The Italian is top-dressed in the following spring with 1½ to 2 cwt. sulphate of ammonia, and sometimes with the addition of 1 cwt. superphosphate. The stubble receives a heavy dressing of farmyard manure, which is ploughed in for the potatoes. The land is in this way kept in good heart and yet not too rich, a condition as inimical to a good seed crop as land low in fertility. Lime is not applied as it is naturally present in adequate amount. The farm is on limestone and this is put forward as a possible reason why the area is famous for high yields of seed.

Harvesting at the correct stage is of the greatest importance. This farmer begins cutting when the kernels have changed from the "milky" to the "firm" state, which generally occurs about the middle of July. In order to cut the seed while in this stage two mowing machines and an abundance of casual labour are kept fully employed; everything is done to expedite the work, and this includes maintaining a good supply of spare parts and sharp mower knives always at hand.

Wet weather tends to delay ripening and harvesting, but Mr. Logan does not object to the hay being tied up wet, so long as his workers are agreeable. In fact, even in dry weather as much as possible is tied in the morning and evening, while the dew is on it, because less seed is shed in this way. A warning is given against the general adoption of the system of tying while wet; it can be carried out with the above crops because they are free from clover and weeds.

The sheaves are stooked in fours, and with average weather it is possible to build them into large "huts" within a week. When the huts are one yard high they are built with a man standing on them; compressed in this way they contain nearly twice as much hay, are firmer, keep out the rain better and are less readily blown over than the ordinary hut. The top is covered with a layer of grass, which is tied down.

Threshing begins as soon as possible, which in a good season may be within a week of completing the hutting. The seed is bagged and the hay baled; both are sold as soon as possible. Yields are rarely less than 10 cwt. and have reached 13 and 14 cwt. per acre, the average on this farm being about 12 cwt. For the country as a whole it is only 7 cwt. per acre (cf. the fen yields).

This farmer, like the earlier growers on the Cambridgeshire fens, believes

[35] Mr. Isaac Logan and his father had been growing Italian ryegrass for seed for 52 years at Ballymagaraghan, Moira, Co. Down.

in obtaining new seed, and renews it for sowing each year, never sowing any which has been produced on his own farm.

Contamination of Seed Crops by "Foreign" Pollen

The writer of the article from which the above information was taken gives as one of the reasons why good quality Italian ryegrass seed can be produced in Northern Ireland the fact that the weather conditions during the summer are comparatively moist and dull. "In countries where summer weather is dry and sunny, and where both Italian and perennial ryegrasses are grown, an appreciable amount of cross-fertilisation between the two ryegrasses takes place at the time of fertilisation, that is, when the flowers set seed. This results in seed that produces unproductive, useless hybrid plants. Under conditions such as prevail in this country (Northern Ireland) practically no crossing occurs, even though there may be fields of perennial ryegrass adjacent to fields of Italian, or even when Italian and perennial plants are growing side by side."

It is difficult to believe that because of weather conditions practically no contamination occurs in the above crops. That the amount of outcrossing may be comparatively small could be due to the operation of two major factors: (a) the areas under the seed crop are relatively large, so that there is within each population an overwhelming abundance of "own" pollen, and (b) the date of heading in perennial ryegrass is decidedly earlier than in Italian. The extent of this difference can be seen from the following figures for *mean emergence dates* for the inflorescences of single-spaced plants of Irish perennial and Irish Italian ryegrasses at Aberystwyth (lat. 52.2°N.)[36] The dates in 1945 an early season, were 26th April and 20th May respectively, and in 1951, a fairly late season, 14th May and 30th May. This gave a difference in mean dates of 24 days in 1945 and 16 days in 1951.

[36] Climatic conditions at Aberystwyth, Wales, are not unlike those in the ryegrass seed growing areas of Northern Ireland during the six months April to September, and especially in the critical month of June, when Italian ryegrass flowers. This will be seen, from the data tabulated below for Aberystwyth (Welsh Plant Breeding Station farm Frongoch, altitude 452 ft., latitude 52.25°N, longitude 4.4°W): Hillsborough, Co. Down (alt. 388 ft., lat. 54.28°N. long. 6.4°W) and Armagh (alt. 205 ft. lat. 54.21°N., long. 6.39°W).

Rainfall: monthly mean (inches)	April	May	June	July	Aug.	Sep.
Aberystwyth	2.38	2.46	2.89	2.34	3.66	3.95
Hillsborough	1.98	2.07	2.84	3.59	3.32	3.54
Armagh	2.12	2.36	2.52	2.82	3.63	2.46
Sunshine: daily mean (hours)						
Aberystwyth	4.89	6.30	6.29	4.82	5.46	4.17
Hillsborough	4.62	6.40	6.09	4.61	4.71	3.66
Armagh	5.01	5.34	5.58	4.70	4.34	3.90
Temperature: monthly mean						
Aberystwyth	45.6	51.4	57.1	58.4	59.0	56.6
Hillsborough	45.0	49.6	55.2	57.9	57.6	54.3
Armagh	45.3	51.1	55.7	58.9	56.1	54.3

I am indebted to my colleague Mr. Ll. Iorwerth Jones, Senior Agronomist at the Welsh Plant Breeding Station who is also in charge of meteorological records, for providing these data. Those of the first two centres are based on the averages for 15 years (1931-39 and 1946-51) when records were available for both places; those for Armagh are the 35 year average.

Griffiths (1950), from investigations carried out near Aberystwyth, showed that the onset of flowering (pollen liberation) followed a sequence in perennial and Italian ryegrasses similar to that for head emergence, but usually about three weeks later ; he also demonstrated that this difference in time of anthesis was insufficient to protect either crop from possible interpollination. He further showed that there could be an overlap in flowering even between extreme strains of ryegrass, e.g. between Irish, which is early flowering, and S.23, which is late flowering. The mean emergence dates for S.23 in 1945 and 1951 were 1st and 8th June, that is, 36 and 25 days after those for Irish perennial.

In order to demonstrate the possibility of contamination by pollen in the different strains use was made of plants of *L. perenne* without the red colouration of the basal sheaths. Such *non-red* plants are *recessive* in respect of anthocyanin colour. Therefore, when pollen from any red-base plant (and most of the ryegrass population is made up of such plants) of *L. perenne* or *L. italicum* falls on to the stigmas of the non-red individual, the resulting progeny all have the red coloured base (Jenkin, 1930). When two non-reds of the same constitution interpollinate the resulting seedlings are all non-red.

Griffiths, using these genetically distinct plants as females, proved that contamination was very considerable between neighbour plants, and that the degree of intercrossing decreased rapidly as the distance between them increased. But the danger of outcrossing persisted to a slight extent even when the source of the " foreign " pollen was several hundred yards away.

It is essential, therefore, especially in the case of special strains, that every precaution be taken to avoid possible contamination by this means, either from within or without the seed production area.

III. Appendixes

III.—APPENDIXES

A. A chronological list of references to works dealing with grasses from 1636 to 1951

B. A list of the reference books used

C. Ray-grass, its place in 17th century Oxfordshire farming, Plot, 1677

D. Pacey's ryegrass: a first-hand contemporary account, Richard Davis, 1794

E. Premiums for ryegrass: the letters of Whitworth and Stickney to the Society of Arts, 1825 and 1826

APPENDIX A

A CHRONOLOGICAL LIST OF REFERENCES TO WORKS DEALING WITH GRASSES, 1636—1951

While the present writer was searching the literature in connection with the history of the grasses, he gradually became aware of, and was impressed by, the remarkably sustained interest shown in the *Gramineae* throughout the past two and a half centuries. It was this fact which prompted the compiling of the following bibliography, which, although not exhaustive, does indicate a remarkable continuity.

Some of the references given deal mainly with husbandry, but they have been included because they drew attention to the different grasses and to their usefulness or otherwise in agriculture. A few Floras have been included because these also were concerned with the value of the grasses and other plants to farm animals. Bentham and Hooker's " Handbook of the British Flora " is mentioned because it has long been a standby of the agricultural botanist. None of the numerous volumes produced under the auspices of the Board of Agriculture has been embodied in the list, although most of them refer to grasses, and some contain material of considerable interest.

The volumes, which have been personally examined, are marked by an asterisk attached to the particular edition seen. Where the titles vary, that of the consulted edition is given. The date before the author's name is usually that of the first known edition. In this way chronological sequence in publication has been maintained.

Dates of reprints and/or new editions are given where known. This is a difficult matter and accuracy cannot be claimed, but all that is intended is to show the popularity achieved by some of the works referred to. This could not have been attempted but for the aid provided by the books of reference set out in Appendix B. That of Perkins (1939) has been a most valuable guide.

A selection of papers from scientific journals has been included in order to indicate trends and developments in research with the grasses, especially during the last thirty years.

The following table shows the distribution in time of the 98 titles which have been listed :—

1626—1650	.....	1
1676—1700	.....	3
1726—1750	.....	1
1751—1775	.....	6
1776—1800	.....	9
1801—1825	.....	13
1826—1850	.....	11
1851—1875	.....	11
1876—1900	.....	12
1901—1925	.....	9
1926—1950	.....	20
1951	.....	2

1636 GERARD, J. The herball or generall historie of plantes. Very much enlarged and amended by Thomas Johnson, 1636.* London, 1st ed. 1597.

1680 MORISON, R. *Plantarum historia universalis Oxenensis.* Only volumes 2 and 3 published, the latter edited by J. Bobart.* Oxford, 1680-1699.

1686 RAY, J. *Historia plantarum* . . . . . London.*

1690 ———— *Synopsis methodica stirpium Britannicarum,* London. 2nd ed. 1696 ; 3rd ed. by J. J. Dillenio, 1724.*

1738 DEERING, Charles. *Catalogus Stirpium* . . . or a catalogue of plants naturally growing and commonly cultivated in divers parts of England, more especially about Nottingham. Nottingham.*

1759 NORTH, Richard. An account of the different kinds of grasses propagated in England for the improvement of Corn and Pasture Lands, Lawns and Walks with many useful directions for sowing them, manuring, etc., and some remarks upon the Perennial Red-flowering clover, and sowing Hay-seeds from fine meadows. . . . . London.*

1759 STILLINGFLEET, Benjamin. Miscellaneous Tracts relating to Natural History, Husbandry and Physick, London.

1762 ———————— Miscellaneous Tracts relating to Natural History, Husbandry and Physick, to which is added The Calendar of Flora and observations on grasses. London, 2nd ed. 1762,* 3rd ed. 1775, 4th ed. 1791.

1762 HUDSON, William. *Flora Anglica : exhibens plantas per regnum Britanniae sponte crescentes.* London, 1 vol. 2nd ed. 2 vols. 1778*.

1766 ANONYMOUS. The complete farmer, or general dictionary of agriculture and husbandry : London, 1769, 1777, 1793, 1807* (2 volumes).

1775 ANDERSON, James. Essays relating to agriculture and rural affairs. London. 2nd ed. 1777, 3rd 1779, 4th 1797 (Vol. III, 1798),* 5th 1800.

1776 WITHERING, William. A botanical arrangement of all the vegetables naturally growing in Great Britain. 2 volumes, Birmingham.* Various editions from 1787 to 1830. 6th ed. 1818 (4 volumes) is entitled " An Arrangement of British Plants. . . . . ."*

1777 LIGHTFOOT, John. *Flora Scotica,* or a systematic arrangement in the Linnean method, of the native plants of Scotland and the Hebrides. London, 2 volumes, 2nd ed. 1789.*

1789 ADAM, James. Practical essays on agriculture : containing an account of soils. . . . An account of the culture of all field plants, including the Artificial grasses. . . . . Also an account of the culture and management of grasslands. . . . . Carefully collected and digested from the most eminent Authors, with Experimental Remarks, London, 2 volumes.*

1790 CURTIS, William. Practical Observations on the British Grasses, especially such as are best adapted to the laying down or improving of Meadows and Pastures : likewise an Enumeration of the British Grasses, London. 1798, 1804, 1805, 1812* (with additions by John Lawrence), 1824,* 1834.

1790 SWAYNE, G. *Gramina Pascua,* or a collection of specimens of common pasture grasses, arranged in the order of their flowering and accompanied with their Linnean and English names as likewise with familiar descriptions and remarks. Folio. Bristol.*

1792 MARTYN, Thomas. *Flora rustica*: exhibiting accurate figures of such plants as are either useful or injurious in Husbandry. Drawn and engraved by Frederick P. Nodder, Botanic painter to Her Majesty, and coloured under his inspection. With Scientific characters, popular descriptions, and useful observations, by Thomas Martyn, B.D., and F.R.S., Fellow of the Linnean Society, and Professor of Botany in the University of Cambridge, London. 4 volumes: I and II, 1792; III and IV, 1794.*

1794 SIBTHORP, John. *Flora Oxoniensis, exhibens plantas in agro oxoniensi sponte crescentes, secundum systema sexuale distributas, Oxonii.**

1799 SOLE, William. An account of the principal English Grasses with descriptions of their respective excellencies and defects in regard to Agricultural uses . . . . Bath.* (The original folio volume, with Sole's hand-painted plates, is in the possession of the Bath and West of England Society.)

1799 SOLE, William. An account of the principal English Grasses with descriptions of their respective excellencies and defects in regard to Agricultural uses. Descriptive part with two coloured plates. Bath and West of England Society's letters and papers on agriculture. Vol. IX, 131-65, 1799.*

1804 KNAPP, J. L. *Gramina Britannica* or representations of the British Grasses, with remarks and occasional descriptions, London. 2nd ed. 1842.*

1804 AMOS, William. Minutes in agriculture and planting . . . illustrated with specimens of eight sorts of the best and two sorts of the worst natural grasses . . .Boston.*

1808 WADE, Walter. Sketch of Lectures on Meadow and Pasture Grasses, delivered in the Dublin Society's Botanical Garden, Dublin.*

1808 WHITE, John. An essay on the Indigenous Grasses of Ireland. With two coloured plates. Dublin.*

1810 PHELPS, Rev. William. *Calendarium botanicum*, or a botanical calendar exhibiting at one view the generic and specific name, the class, order and habitat of all the British plants . . . . arranged according to their time of flowering and the month of the year. London.*

1810 SALISBURY, William. On raising grass seeds and preparing meadow land. Nicholson's Journal, 26: 355-60.*

1812 SALISBURY, William. *Hortus Siccus Gramineus*: or a Collection of Dried Specimens of the British Grasses.

1813 DAVIES, Hugh. Welsh Botanology, London.*

1816 SALISBURY, William. The botanists companion: or an introduction to the knowledge of practical botany and the uses of plants. Either growing wild in Great Britain, or cultivated for the purposes of agriculture, medicine, rural oeconomy or the arts. London. 2 volumes.*

1816 SINCLAIR, George. *Hortus Gramineus Woburnensis*: or, an account of the results of experiments on the produce and nutritive qualities of different grasses and other plants used as the food of the more valuable domestic animals: instituted by John, Duke of Bedford, London. Folio edition with dried specimens of the grasses.* Other editions without specimens 1824, 1825, 1826,* 1869.

1822 GRAVES, George. A monograph on the British Grasses, London.* (With 91 coloured plates).
1824 SMITH, J. E. The English Flora. 4 volumes, London. 2nd ed. 1828.*
1825 LOUDON, J. C. An encyclopaedia of Agriculture, London,* 1826, 1831, 1835, 1839, 1844, 1857, 1871, 1883, 1884.
1829 ———— An encyclopaedia of plants, all the plants indigenous, cultivated in or introduced to Britain, London.*
1834 LAWSON, Charles. On the kinds and quantities of grass seeds suited to alternate husbandry, permanent pasture, pleasure grounds, etc. Quarterly Journal of Agriculture, IV, Nov. 1833.
1842 DONALDSON, J. A treatise on Manures, their preparation and application with a description and use of the most approved British Grasses, to which is added a miscellaneous article on farming with an estimate and description of an example-farm of three hundred acres with illustrated cuts of farm buildings. London. 1846.*
1842 PARNELL, Richard. The Grasses of Scotland. Edinburgh.*
1842 LAWSON, Peter and Son. *Agrostographia*, a treatise on the cultivated Grasses and other Herbage and Forage plants, Edinburgh.* 1846, 1850, 1853*, 1855, 1877* (revised by D. Syme).
1843 MOORE, David. Concise notices of British grasses best suited for agriculture. London. 1850, 1851,* 1856.
1845 PARNELL, Richard. The Grasses of Britain. Edinburgh.*
1846 MURPHY, Edmund. A treatise on the agricultural grasses. Dublin. (Copy in British Museum dated 1846, but the catalogue of Royal Agricultural Society of England gives 1844.)*
1846 HANHAM, F. Natural illustrations of the British Grasses. Illustrated by herbarium specimens. Folio. Bath.
1847-56 WILSON, Rev. J. M. The rural cyclopedia, or a general dictionary of agriculture. . . . . Edinburgh, London and Dublin.*
1849 BARRATT, William. On grasses in alternate Husbandry.
1852 PRATT, Anne. The green fields and their grasses, London. 1854.
1855 DICKINSON, William. Instructions for growing Italian Rye Grass, London.
[1857] SOWERBY, J. E. and JOHNSON, C. The Grasses of Great Britain. Illustrated by Sowerby, described with observations on their natural history and uses (by) Charles Johnson. London. No date.*
1858 BUCKMAN, James. The Natural History of British meadow and pasture grasses with an account of their economy and agricultural indications. London.* 73 pp. (See also Journ. Roy. Agric. Soc. Eng. 1857, Vol. 17 : 162-72 and 513-42.)
1858 LOWE, E. J. A natural history of British grasses. London.* 1864, 1871, 1891.
1858 BENTHAM, G. and HOOKER, J. D. Handbook of the British Flora. London.* 5th ed. 1886 ; 6th ed. 1892, etc.
[1859] PRATT, Anne. The British Grasses and Sedges. London. No date.*
1862 TOOGOOD, William. Pastures and Pasture Plants. Southampton.* 1897 edition by W. G. Toogood, London.
1867 PLUES, Margaret. British grasses : an introduction to the study of the Gramineae of Great Britain and Ireland. London.*

1868 ANONYMOUS. The Country Gentleman's Magazine. Vol. 1, etc. London.*

1872 DEAN, G. A. The Culture, Management and Improvement of Landed Estates . . . with numerous illustrations: those of Grasses and Insects taken from nature. London.*

1884 GUNN, W. Specimens of British Grasses. Folio, Dublin. (No title page, according to Perkins.)

1885 ROBSON, A. Agricultural Grasses, Aberdeen.

1886 SUTTON, M. J. Permanent and Temporary Pastures: with descriptions and coloured illustrations of leading natural grasses and clovers. London,* 1888, 1891.

1887 PRESTON, S. P. Pasture grasses and forage plants, and their seeds, weeds and parasites. London.*

1889 WILSON, William, Jr. Practical observations on agricultural grasses, and other pasture plants. 2nd ed. London.*

1889 WILSON, William, Jr. Notes on the botany of the district around Alford. (A paper read before the East of Scotland Union of Naturalists in August, 1888.) Scottish Naturalist, 1888-9.*

1889 MCALPINE, A. N. The best forage plants fully described and figured with a complete account of their cultivation, economic value, impurities and adulterants, etc. A translation of *Die besten Futterpflanzen* by F. G. Stebler and C. Schröter. London.*

1890 M'ALPINE, A. N. How to know grasses by the leaves. Edinburgh.*

1895 HUTCHINSON, William. Handbook of grasses, treating of their structure, classification, geographical distribution and uses, also describing the British species and their habitats. London, 1899.*

1896 HACKEL, E. The true grasses. English translation by L. Lamson-Scribner and Effie A. Southworth, London.*

1896 WILSON, William, Jr. Investigations into applied nature. London.*

1898 ELLIOT, R. H. Agricultural changes.* 1900, 1904. In 1908 the title was altered to "The Clifton Park System of Farming, and laying down land to grasses . . . ." London. 1908,* 1943.*

1901 WARD, H. M. Grasses: a handbook for use in the field and laboratory. Cambridge Univ. Press.* Reprinted 1908.

[1907] GORDON, W. J. Manual of British Grasses—with a coloured illustration of every species and many original diagrams by J. T. Gordon. London. No date.*

[1907] THORNHILL, John. Collection of British pasture and meadow grasses. No date.

[1910] STAPLEDON, R. G. Grasses. (A Key) Printed for private circulation. Cirencester. No date.*

1917 ARMSTRONG, S. F. British Grasses and their Employment in Agriculture. Cambridge Univ. Press,* 1937.*

[1920] CRABTREE, J. H. Grasses and rushes, how to identify them. London. No date.

1920 MCGILL and SMITH. British Grasses. Preface by J. F. McGill, Ayr. 65 plates.* (A book of photographs of specimens mounted by A. M. Mackie.)

1924 JENKIN, T. J. The artificial hybridization of grasses.* Bulletin Series H. No. 2, Welsh Plant Breeding Station, Aberystwyth.

1925 ———— Pasture Plants. Farm Crops. Edited by W. G. R. Paterson. Vol. III. Pastures and Hay. London. 4 volumes.*

1928 GREGOR, J. W. Pollination and seed production in the ryegrasses (*Lolium perenne* and *Lolium italicum*). Trans. Roy. Soc. Edin. 55, 773-94.*

1928 STAPLEDON, R. G. Cocksfoot grass (*Dactylis glomerata* L.): Ecotypes in relation to the biotic factor. J. Ecology, 16, 71-104.*

1930 JENKIN, T. J. Perennial ryegrass at Aberystwyth. Welsh J. Agric. 6, 140-65.*

1931 BEDDOWS, A. R. Seed setting and flowering in various grasses. Welsh Plant Breeding Station Bulletin Series H. No. 12, pp. 5-99.*

1931 JENKIN, T. J. Self-fertility in *Lolium*, *Phleum* and *Festuca*. *Ibid.* pp. 100-160.*

1931 STAPLEDON, R. G. Self- and cross-fertility and vigour in cocksfoot grass (*Dactylis glomerata* L.). *Ibid.* pp. 161-180.*

1931 FISHER, Robert. Flowers of Grass. How to know the names of British Grasses. London.*

1931 JENKIN, T. J. The method and technique of selection, breeding and strain building in grasses. Imp. Bur. Plant Genet. Herb. Plants, Aberystwyth. No. 3, pp. 5-34.*

1931 STAPLEDON, R. G. Methods as applied to cocksfoot grass (*Dactylis glomerata* L.) and remarks as to technique in general. *Ibid.* pp. 35-45.*

1933 BURR, S. and TURNER, D. M. British economic grasses, their identification by the leaf anatomy. London.*

1933 JENKIN, J. T. Interspecific and intergeneric hybrids in herbage grasses —initial crosses. J. Genet. 28, 205-64.*

1933 PETO, F. H. The cytology of certain intergeneric hybrids between *Festuca* and *Lolium*. J. Genet. 28, 113-56.*

1937 BEDDOWS, A. R. The shape of the shoot-bud prophyll in the ryegrasses and broad-leaved fescues as a diagnostic character for their separation in the field. Welsh J. Agric. 13, 190-5.*

1938 THOMAS, J. O. and DAVIES, L. J. Common British Grasses and Legumes. London.*

1938 JENKIN, T. J. and THOMAS, P. T. The breeding affinities and cytology of *Lolium* species. J. Bot. London, 76, 10-12.*

1940 THOMAS, J. O. Grassland. Young Farmers' Club Booklet No. 6, National Federation Y.F.C., Radlett, Herts.*

[1942] STOKOE, W. J. The Observer's Book of British Grasses, Sedges and Rushes. London. No date.

[1949] STOKOE, W. J. The Observer's Book of British Grasses, Sedges and Rushes. Revised and extended by A. Laurence Wells. No date.*

1949 COOPER, J. P. and SAEED, S. W. Studies on growth and development in *Lolium*. I. Relation of the annual habit to head production under various systems of cutting. J. Ecol. 37, 233-59.

1950 COOPER, J. P. Day-length and head formation in the ryegrasses. J. Brit. Grassland Soc. 5, 105-12. With 5 plates.*

1951 COOPER, J. P. Studies on growth and development in *Lolium*. II. Pattern of bud development of the shoot apex and its ecological significance. J. Ecol. 39, 228-70.*

1951 JENKIN, T. J. Genetic problems in the breeding of forage grasses. In Proceedings of the Congress on Agricultural Genetics, Rieti, Italy, 30th May—2nd June, 1950.*

APPENDIX B

LIST OF THE REFERENCE BOOKS USED

Bath and West of England Society (1864). Catalogue of books by C. P. Russell, London.

Royal Agricultural Society of England (1918). Catalogue of the Library, by G. E. Manwaring. London.

Linnean Society of London. (1925). A catalogue of the printed books and pamphlets in the library. New edition by Spencer Savage. London.

National Library of Wales (1926). A hand-list of books on agriculture. Aberystwyth. 3rd edition.

Royal Horticultural Society (1927). A catalogue of books, pamphlets, manuscripts and drawings in the Lindley Library by H. R. Hutchinson, London.

Ministry of Agriculture and Fisheries (1930). Chronological list of early agricultural works in the library of the Ministry of Agriculture and Fisheries, by G. E. Fussell, London.

Perkins, W. Frank (1939). British and Irish writers on agriculture. Lymington, 3rd edition.

Rothamsted Experimental Station (1940). Library catalogue of printed books and pamphlets on agriculture, published between 1471 and 1840, by Mary S. Aslin. Aberdeen, 2nd edition.

University of Cambridge, School of Agriculture (1950). Agricultural periodicals of the British Isles, 1681-1900, and their location. Compiled by F. A. Buttress, Cambridge.

APPENDIX C

RAY-GRASS, ITS PLACE IN 17th CENTURY OXFORDSHIRE FARMING, PLOT, 1677

Plot's Natural History of Oxfordshire (1677) is referred to in most works dealing with perennial ryegrass. The account he gives shows that its place in mid-seventeenth century alternate husbandry was surprisingly well established for a grass which was "lately sown".

The agricultural place of any recently introduced crop is usually found only after the "new" plant has been tried out in the district for some considerable time. It is therefore probable that the use of ryegrass in alternate husbandry had become established some time before Plot toured Oxfordshire collecting material for his book.[37] Where in England the possibilities of ryegrass as a herbage plant were first realised will probably never be known, but how they might have come to be recognised has already been suggested (see p. 8).

As Plot's Natural History of Oxfordshire is not readily accessible his report on ray-grass is given in full below. What he says about other crops is quoted only when relevant to our purpose.

[37] In this he was the forerunner of Arthur Young, William Marshall and others.

p. 143. Chap. VI. "*Of Plants.*"

p. 150. Par. 23-30. "Of *unusual plants* now cultivated in the fields . . . . ."
(He describes some wheats, barley and peas)

p. 153. Par. 31. "As for *Beans* and *Oats*, they sow only the common that are everywhere else, but for *Grasses*, the usual name for any *Herbage* sown for cattle, especially if *perennial* (to pass by the *trifolium purpureum majus sive sativum, Clover* grass; and *Onobrychis spicata flore purpureo, semine echinato*, commonly called *Sainct-foin*, or *Everlasting*-grass; but according to Dr. *Morison*, the true *Lucerne*, now every where known, and therefore nothing concerning the qualities and advantages of *it*). They have lately sown *Ray-grass*, or the *Gramen Loliaceum*, by which they improve any *cold, sour, clay*-weeping ground, for which it is best, but good also for dryer *up-land* grounds, especially *light stony* or *sandy Land*, which is unfit for *Sainct-foin*."

p. 154. Par. 32. "It was first sown (as I was told) in the *Chiltern* parts of *Oxford-shire*, and since brought nearer *Oxford* by one Mr. *Eustace*, an ingenious Husband-man of *Islip*, who though at first laught at, has been since followed even by *those* very persons that scorn'd his *Experiment*, it having precedence of all other *grasses*, in that it takes almost in all sorts of *poor* Land, endures the *drought* of *Summer* best, and in the *Spring* is the earlyest grass of any, and cannot at that time be over-stock'd; its being kept down making it sweeter, and better beloved by *Cattle* than any other grass: Nay, sometimes they have been known to leave *Meddow hay* to feed on *this*; but of all other *Cattle* it is best for *Horses*, it being hard Hay; and for *Sheep*, if unsound, it having been known by experience to have work'd good *cures* on *them*, and in other respects the best *Winter* grass that grows."

p. 154. Par. 33. "As to the *manure* of it, some sow but two *bushels* on the *Statute Acre*, but 'tis best to sow three, mixt with the *trifolium agrarium Dodonaei*, called *Melilot-trefoil*, and somtimes *Non-such*, because of it self it is but a thin spiry *grass*, and will not be of any bulk the first year, unless thickned by the *Trefoil*, which failing by degrees, the *Ray* or *bennet-grass* (so some also call it) thickens upon it and lasts for ever. Of *Ray-grass* and *Trefoil* thus mix'd together, one at *Islip*, but lately had so advantagious a *crop*, that from four *Statute* Acres, worth not above *forty shillings per annum*: beside the keeping six or eight *cattle* till *holy Thursday*, and the feeding all the *Winter* following, had twenty Quarters of Seed worth twenty pounds, and fourteen loads of *fodder*, enough to winter five or six *cattle*."

p. 214. Chapter IX. "Of Arts"

p. 239. Par. 56. "To these succeed the *Arts* relating to *Earths*, which either respect the *Tillage*, or *Formation* of them. . . . ."

p. 240. Par. 58. ". . . . . But if so cold a *weeping Clay* that unfit for these" (wheat, barley, peas, vetches) "then they improve it with *Ray-grass*."

p. 240. Par. 59. "As for the *Chalk-lands* of the *Chiltern-hills* . . . . . But if it be of that poorest sort they call *white-land*, nothing is so proper as a ray-grass mixt with *Non-such*, or *Melilot Trefoil*, according as prescribed in Chapter 6, Para. 33."

p. 242. Par. 64. "In some parts of the *County* they have another sort of *Land* they call *Stone-brash* . . . . . ."

p. 243. Par. 65. ". . . . . These are sown also many times with *Dills* or *Lentils*, and when quite worn out, or so poor that they will bear nothing else to advantage, they are yet fit for *Ray-grass* mixt with *Trefoil*, as prescribed above in the Chapter of *Plants*."

p. 243. Par. 67. "As for *stony Land*, whereof there is but little can be properly so called but in the *Chiltern Country*, they give it for *Wheat*, *Peas*, and *Barly*, much the same *tillage* and *manure*, they do *Clay* in other places, adding the advantage of *chalking* it, ... for when once the *manure* by chalk is worn out, the Land is scarce recoverable by any other, whence 'tis *Proverbial* here, as well as some other parts of *England*, That *chalkt Land* makes a rich *Father*, but a poor *Son*, thereby intimating the ruin of the land in the end, it becoming at last only fit for *Ray-grass*, mixt with *Trefoil* as above."

p. 249. Par. 83. "As for the *Grasses* sown in this *County*, I have little more to add concerning them, ... only that (p. 250) it has been found most agreeable that *Sanct-foin*, *Ray-grass*, etc., be not sown presently after the *Barly*, *Oats*, or whatever other *Grain* it be sowed with, but rather after the *Corn* is come pretty high, so that it may shelter the *seed* from the heat of the *Sun*, which, as is apprehended at least, is somtimes prejudicial. And that in the *Chiltern Country*, after they have eaten off their *Ray-grass* or *Sainct-foin*, they find it advantagious to *fold* it with *Sheep*, as other *Corn-lands*, which I thought good to note, it being, as I am informed, but lately practised.

APPENDIX D

PACEY'S RYEGRASS: A FIRST-HAND CONTEMPORARY ACCOUNT, RICHARD DAVIS, 1794

The following report is taken from *General View of the Agriculture of the County of Oxford* by Richard Davis (1794), pp. 18-20.[38] It has been reproduced in full because of its significance as the only contemporary description known to be based on actual knowledge of the grass and its producer. Davis also makes it clear that Pacey was a pioneer too in the culture of cocksfoot, also less precisely referred to as "orchis" grass by another contemporary (George Turner, 1794).

> "As it is very desirable to bring pasturage to perfection on arable lands, I shall beg leave before I quit the subject of grasses to mention a new species of ryegrass; and though to do this I must pass a little beyond

[38] This report on the special ryegrass at Northleach was also reprinted by Arthur Young (1809) in the second report on Oxfordshire, pp. 210-212.

the bounds of this county, I trust the digression will be excused, on account of the importance of the occasion, as I am fully convinced from repeated observations at different seasons that the grass in question has a manifest superiority over the common sorts. It should also be noted, that the spot where I viewed this grass, at Northleach in Gloucestershire, is of that shallow stone brash kind, with which a considerable tract of Oxfordshire, about Burford, abounds.

The excellencies peculiar to this species of rye grass are the following:

1st. That in the autumn, when the other sorts are become of a russet hue, withered and decayed, and produce little feed, this is luxuriant and growing; the tufts thereof spreading over more than twice the space of ground that the common sort does.

2dly. That it will remain in the ground for seven or eight years, or more, depending in the quality of the land; whereas the other sort will not continue above one or two years, which is too short a time to give sufficient rest to the poorer sorts of land.

3dly. A peculiar advantage arises by its being *hained*[39] up about *Michaelmas*, or before, whereby it will grow at all open times during the winter, and produce a valuable pasturage for the ewes and lambs in the spring of the year, when the turnips are gone.

The merit of discovering and cultivating this grass is to be attributed to that ingenious and intelligent farmer at Northleach, whose attention to the breed of sheep has made his name so well known to the public. It first attracted his notice by continuing amongst sainfoin which had stood seven years; the seed was therefore first selected from this sort, and from time to time multiplied, till the cultivator has been able to accommodate many of his friends, and the public (who have now found out its value) with considerable quantities of the seed, but not so much as has been largely required; 50 quarters have been sent for in one order in 1792, when the whole that was raised that year did not exceed 16 quarters. It therefore seems to be of public utility that this valuable seed should be disposed of in smaller quantities, in order that it may be more universally dispersed; and it has been the advice of several gentlemen, well wishers to improvements in agriculture, to raise the price to 10s. 6d. per bushel, including new sacks to send it in; which would have the good effect of causing those farmers to save seed, who now feed it off, under an expectation of procuring more seed from the same place, at the original price of 5s. 0d. per bushel; and the cultivator is undoubtedly entitled to such an advance, for his attention to the public interest in selecting, cultivating, and preserving the seed. One bushel is sufficient to sow an acre; and as the plant comes up weak the first year, it is advisable to sow it amongst corn, in order that the weeds may not get the better of it; or it may be sown with turnips by first hoeing, and then harrowing it in. But if the land is intended to be a permanent greensward, a mixture of the *Dactylis glomerata*, a rough cock's foot grass, would prove beneficial, the seed of which is now selecting also by the same person."

[39] To hain: to shut up grassland from stock.

APPENDIX E

PREMIUMS FOR RYEGRASS: THE LETTERS OF WHITWORTH AND STICKNEY TO THE SOCIETY OF ARTS, 1825-1826

These letters[40] are reproduced because of the information they provide of the way in which these early 19th century improvers produced their strains of perennial ryegrasses, and how these differed from the forms ordinarily grown in season of growth, productivity and persistence. The correspondence incidentally reveals something of the character of the men themselves.

The Society of Arts indicate their purpose in offering premiums in the "General Notice" to candidates: "the great object of the Society in rewarding individuals is to draw forth and give currency to those inventions and improvements which are likely to benefit the public at large. . . . ."

The conditions governing the award for an improved ryegrass were set out in Vol. 42 of the Society's Transactions (1823-4), page IX, under premium 22: "Rye grass. To the person who shall produce to the Society a specimen of Perennial Rye Grass (*Lolium perenne*) being from a stock originally of his own selection, which shall possess properties of coming to a sward in less time than varieties hitherto cultivated; and which shall be perennial, more abundant, of better quality, and as early as the most forward of varieties usually sown—the silver medal."

"It is required that five pounds of the seed, and a specimen of an entire plant of the grass be forwarded with the communication."

"Certificates of the candidate having cultivated the variety produced not less than six years, of his having, at the time of making the communication at least 10 acres sown with it, and of its superiority over other varieties of the same species: to be produced to the Society on or before the last Tuesday in February, 1825."

The First Award

The Silver Ceres Medal was this session presented to George Whitworth, Esq., of Acre House, near Caistor, Lincolnshire, for an improved variety of *Lolium perenne* or Ray Grass, raised by him. The following communication has been received from the candidate, and seeds of the grass are in the Society's possession.[41]

"London, March 9th, 1825.

Sir,

Observing amongst the premiums offered by the Society of Arts, etc., a medal for the production of a specimen of *Lolium perenne* possessing superior qualities to the kinds hitherto cultivated, I beg to offer a variety which I selected and have grown for many years, and which, from the experience resulting from my particular enquiries into the properties and habits of the perennial ryegrasses I have found to be of more value than any other coming under my notice, being early in its growth in the spring, productive in its foliage and giving, I believe, more nutritive value than any other. This grass has also the advantage of yielding a fair quantity

[40] Transactions of the Society of Arts, Vols. 43 and 44 for 1824-5 and 1825-6 respectively.

[41] The samples are no longer in existence. A.R.B.

of seed, which ripens tolerably early, and may, from this circumstance, be profitably cultivated in some of the late ripening districts, or in situations of considerable elevation. The aftermath, or autumnal produce, is equal to that of any with which I am acquainted and this plant not only keeps its verdure in the winter months but, in moderately open weather, always continues to grow at that season. To give some idea of the value of this ray grass, I beg to state that a field of upwards of 20 acres was sown down in April 1819, with about two pecks and a half per acre of seed. This piece of land was cropped for seed in 1820, 21, 22, and 23, four years in succession ; in the autumn of the latter year, being then a full and fine sward, part of it was broken up for wheat, and the residue for oats, in the following spring, the whole being in a remarkably clean state. I believe it is generally known that I have devoted much time to the cultivation of ray grass and I trust that I may be presumed to possess some information on the subject. I feel it right to avail myself of the opportunity afforded by the Society of presenting the accompanying specimens and seed of my variety, and I shall be happy to give every information that may be further wished connected with the subject.

I have the honour to be, sir,
etc.
George Whitworth.

A. Aikin, Esq.,
Secretary."

Certificates from neighbouring farmers who have tried the grass, assert that it is far superior to the usual varieties both in the bulk of produce, early growth and durability.

The Second Award

The Large Silver Medal was this session voted to Mr. W. Stickney of Ridgmont, near Hull, for a variety of Ray-grass superior to those commonly in cultivation. The following communication has been received from Mr. Stickney on the subject.

" Ridgmont, near Hull,
1 Mo. 16, 1826.

Respected Friend,

A friend of mine having handed me a list of premiums offered by the Society of Arts, etc., amongst which is the silver medal for a specimen of ray grass, and described in No. 23 of that list ; and flattering myself that I have for several years been cultivating a sort which fully answers every description there given, I hereby offer myself as a candidate for No. 23 in your list, hoping that the printed description of the grass, with the annexed certificate of its merits signed by several of my neighbours well acquainted with it ; together with a few pounds of the seed, which I will take care to send, will be as much as will be required ; but if a specimen of an entire plant is expected, I will take care to send as complete a one as the season of the year will afford. I am afraid no seed stems can at present be procured ; but if as much of a plant as the season will afford is expected,

I will thank thee to inform William Iveson, who I expect will be the bearer of this, and he will communicate the same to me.

I am, very respectfully, thy friend,
Wm. Stickney.

A. Aikin, Esq.,
Secretary, etc."

"Ridgmont, near Hull,
1 Mo. 25, 1826.

Respected Friend,

I sent by the post, on the same day on which I sent the grass seed, a written communication, addressed to thee, offering myself as a candidate for the medal, and also a written certificate, signed by the persons whose names are attached to the printed one, except one, viz. Richard Brigham, who is since deceased, which certificate I apprehend will comprise all that is required by the conditions. I am aware that the printed paper is more than you require; but as I wish nothing to be kept secret as to the manner of my obtaining the grass, I thought, as the printed paper gave full description of that, it possibly might be a hint to others, by which they might probably obtain a variety even superior to mine. I have now six or seven other sorts coming forward, some of which promise to have qualities superior to this now offered to your notice, but I have not yet had sufficient time fully to ascertain their merits.

As a complete plant, furnished with a seed stem, cannot at this season of the year be procured I had requested my friend to inquire whether that part of the requisition was expected; if it is I wish thee to inform me immediately, and such as the season will afford I will send. Perhaps a small sod, of a few inches diameter fixed in a flower pot will be the best.

I am, very respectfully, thy assured friend,
Wm. Stickney.

A. Aikin, Esq.,
Secretary, etc."

"Ridgmont, near Hull,
2 Mo. 20, 1826.

Respected Friend,

I have herewith sent thee some specimens of my grass. Nos. 1, 2, 3 and 4, were gathered the second of this month: the seed of this was sown without a crop of corn, and without any manure on the land, the 18th of September, 1824. In the summer of 1825 it was seeded; the plants still have some of the old leaf and the stubble of the seed-stems attached to them. No. 1 was a plant rather detached from the general sward; the others were taken from where it was more thickly matted. Nos. 5, 6, 7 and 8, gathered at the same time, are plants from seed sown on the 23rd of September, 1825, but on account of the dryness of the soil did not vegetate, so as to be perceptible, until November. The land was fallowed, being well cleaned, and no manure applied except lime; manure is not

applied, lest it should bring the seeds of other plants. Nos. 9 and 10 gathered the 3rd February ; sown with clover on wheat the 22nd of April, 1825. From this field was reaped a heavy crop of wheat, and is now intended for grazing the next summer. Nos. 11, 12 and 13, gathered the 16th of February and from the same as 5, 6, 7 and 8 as described above. Nos. 14, 15 and 16 gathered the 16th, from the same as 9 and 10 described above. Nos. 17 and 18 gathered the 16th from the same as 1, 2, 3 and 4, as described before. Notwithstanding all these are plants of the same grass, yet they vary very much, according to soil, situation and other local circumstances.

In thy last letter thou asks me if I know anything of the comparative merits between Mr. Whitworth's grass and mine. With Mr. Whitworth I have been acquainted for some years ; his grass I have never seen. I have requested at different times (for some years past), that he would furnish me with some of his seed, in order that I might contrast it with mine ; he has promised to do so, but has hitherto failed. The greatest proportionate demand for my grass (except in my own immediate neighbourhood) is in the north of Lincolnshire, where I suppose Mr. Whitworth's will be most known.

Had I not received thy last letter, describing the manner of drying and preparing the plants you have requested to have, it was my intention to have sent you some specimens of the sward of my grass, from eight to ten or twelve years standing. Its most peculiar merit consists in forming a thick, luxuriant, and durable sward, and growing in all seasons of the year when the weather is mild. It is the least affected by drought of any grass in my knowledge ; when other pastures are burnt up, in dry weather, it will exhibit a fine luxuriant verdure.

I am, very respectfully, thy assured friend,
Wm. Stickney.

A. Aiken, Esq.,
Secretary, etc."

Certificates

" Ridgmont, October 2nd, 1817.

We, the undersigned, occupiers and cultivators of land in Holderness, have this day viewed several plots of land, sowed at different periods of time by Mr. William Stickney, on his farm at Ridgmont with the particular grass seed cultivated by him, and the specimens show that the sward of this grass is more readily formed and of much better quality than any other grass with which we are acquainted ; and whether in permanent pasture or in seeding land, its superiority is sufficiently apparent.

Joseph Storr, Robert Bell, Robert Stubbing, Thomas Dodds,
John Collins, William Iveson, John Taylor, Richard Brigham.

(Footnote : Mr. Brigham is since dead.)

About the year 1802 I commenced cultivating several sorts of grasses. I soon discovered that those worthy of cultivation were but few in number. Amongst several sorts I was then in possession of, I found a variety of the ray-grass to have merit beyond any other : this variety I had selected from some particular rich looking plants. I continued to extend the cultivation

of it for several years. About the year 1806, I formed an opinion, from observation, that some of our richest pastures continue their richness and verdure without the grasses ever being reproduced from seed. The appearance of the little field, in the front of the house of my friend Richard Brigham, led me to this conclusion : I had observed it to be always eaten very bare and never knew any of it produce seed ; I therefore concluded it must be stocked with grasses of a permanent kind, and had a good deal of curiosity to ascertain what they were. I obtained of my friend, R. Brigham, a small sod considerably less than a square yard. I placed it in a situation where it had an opportunety of showing its seed, and to my great surprise it proved to be, nearly without exception, the variety of ray-grass now before the Society.

I continued to extend its cultivation every year, continuing also to contrast it with the best purchased ray-grasses and other grasses I could procure, and it has always maintained a very great and decided superiority. I was rather apprehensive for some time that its merit might have consisted in habit which it had acquired by soil or situation, or rather by the particular manner in which it had been treated (being always grazed), and that when it came to be cultivated like other ray-grass it might degenerate ; but after more than ten years cultivation I did not find that that was perceptibly the case.

It has the property of forming a thick matted sward from the abundance of bottom grass which it continually puts out, and it continues to grow at all seasons of the year when the weather is mild. From this variety having established itself in most of the richest and best pastures in Holderness, to the almost total exclusion of the other grasses, it has obtained the name of Old Holderness.

W.S."

" We certify that the variety of perennial ray-grass, *Lolium perenne*, of which a specimen is produced by Mr. William Stickney, of Ridgmont, in Holderness, has been cultivated by him, on his farm at Ridgmont, more than eight years ; that he now has more than ten acres sown with it, for the produce of seed ; more than forty acres sown entirely with it, and laid for swarth, of several years growth ; and more than eighty acres sown along with red or white clover, and intended for hay or grazing for two or three years. We also certify that in our opinion it is superior to any other variety of the same species of grass ; and referring to the annexed certificate, which we gave in the year 1817, we have no hesitation to add, that our subsequent observations and experience have enabled us to confirm the opinions then given by us.

Given under our hands this 16th of January, 1826.

Robert Bell, John Collins, John Taylor, Thomas Dodds,
Robert Stubbing, Joseph Storr, William Iveson."

Specimens of the grass, as described in Mr. Stickney's second letter, are in the Society's collection.[42]

[42] Specimens not now to be found.

Information regarding Stickney's farm and system of farming, and his ryegrass, is given in an account of a visit to Ridgmont by a Mr. Charles Howard, of Melbourne, York. His report, dated September 25th, 1833, was published by the " Society for the Diffusion of Useful Knowledge," along with those on nine other farms, as Vol. III, 1840, of their series—" British Husbandry".

Ridgmont is described as consisting of 840 acres of uniform land all within a ring fence. Although the farm was let on a year to year tenancy, it had been then occupied by the Stickney family for over 100 years, and " its high condition and general neatness are alike creditable to the proprietor, to his land agent and to the tenant".

The reporter describes how after the Napoleonic war the price of grain fell rapidly and rents could not be paid. Tenants as well as proprietors considered the depression temporary and the former continued to plough out more grassland while the latter were unwilling to start reducing rents. It is stated that a good policy would have guarded cautiously against the change. " The difficulties that attend laying down land to permanent pasture with a probability of success are known to every farmer, and it is only the most intelligent and spirited that ever make the attempt. White clover and Pacey's Rye Grass are good as far as they go."

Stickney's account of his method of improvement differs but slightly from that given above, but the following information not given to the Society of Arts shows his faith in the value of his own strain : " From my observation of the superior merits of this grass in various situations, and from the favourable results of many experiments with it upon this farm, I am almost inclined to think that, with due attention to its culture, it will supersede the necessity of cultivating any other sort ; for it appears to have almost every property which we want in grass—it is early—continues its verdure to the latest period—it is permanent—much relished by cattle of all descriptions—and abundant in produce. . . . . ."

The reporter did not think that Stickney had over-rated the value of this grass, and he had seen it at different periods of growth, and ages, and in a variety of situations. He had seen at Ridgmont pastures solely laid down with it of eight to ten years of age which had " really the close and matted verdure of old grass land". The reporter had also tried it out himself " upon a small scale on light sandy soil, where its amazing produce and excellent qualities are most fully shown. On the whole it appears to be an invaluable grass for principal use in the formation of permanent pastures and meadow land, and it may also be sown with great advantage for temporary grass leys".

Howard also reported on the farming of Messrs. T. and Jas. Watson at Wauldby, a 1,000-acre farm, also in the East Riding of Yorkshire. The Watsons bred and fattened a very large number of sheep, and cultivated a large acreage of barley, which was undersown with seeds.[43] The fertility of the land was improved through a system of alternate husbandry which increased the yield of cereals and the stock-carrying capacity of the farm.

The old permanent pastures of the Wolds were replaced by new permanent pastures of greater value. In the case of two-year leys, the kind of rye grass " usually adopted for this purpose has been that which is known by the name

[43] The seeds mixture used consisted of 17 lb. white clver, 2lb. ribgrass, 3 lb. red clover, ¾ peck perennial ryegrass per acre.

of Pacey's perennial ryegrass ; this is more leafy, and spreads more over the ground than that which used formerly to be cultivated under the name of tall or annual ryegrass. There is, however, a new variety of ryegrass cultivated at Wauldby, which appears to the reporter to be as much superior to Pacey's[44] as this latter is to the annual species. The plant alluded to is called " Stickney's ryegrass". This forms a closely-matted sward, is abundant in produce, and continues to exhibit a beautiful verdure through the summer. It is probable that an increased knowledge of this grass will greatly promote the formation of permanent pastures, for which purpose it seems likely to be of essential value". This report was dated 15th January, 1833, and therefore preceded by eight months that on Stickney's farm.

A tract (Anon. 1835) contains a seeds mixture for permanent grass in which the writer recommends " one peck of best Dwarf or Stickney Rye Grass, if it can be secured quite clean".[45]

[44] It must be borne in mind that the so-called Pacey's ryegrass then in use was the produce of many generations of multiplication, so that the type would have deteriorated from the original as grown by Pacey at Northleach. This latter must have been fairly similar in type to Stickney's strain, which itself in time lost its identity and for the same reasons.

[45] The force of this injunction is somewhat spoilt because he also advocates the sowing of "from one to four sacks of good hay seeds gathered from the best meadows". The mixture given is an interesting one: white clover 10 lb. cow grass 3lb. ribgrass 2 lb. trefoil 2 lb. timothy grass 2 lb. parsley 2 lb. with the addition of the hay seeds and the Stickney' ryegrass.

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